#### UNCLASSIFIED

#### AD NUMBER

#### AD316982

#### **CLASSIFICATION CHANGES**

TO: unclassified

FROM: confidential

#### LIMITATION CHANGES

#### TO:

Approved for public release, distribution unlimited

#### FROM:

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; MAY 1960. Other requests shall be referred to Department of the Army, Aberdeen Proving Ground, MD.

#### **AUTHORITY**

CSL D/A ltr, 16 Mar 1981; CSL D/A ltr, 16 Mar 1981

## **UNCLASSIFIED**

AD NUMBER
AD316982
CLASSIFICATION CHANGES
ТО
confidential
FROM
secret
AUTHORITY
21 14 1070 7 77 5000 10
31 May 1972, DoDD 5200.10

THIS PAGE IS UNCLASSIFIED

THIS REPORT HAS BEEN DELIMITED

AND CLEAREL FOR PUBLIC RELEASE

UNDER DOD DIRECTIVE 5200.20 AND

NO RESTRICTIONS ARE IMPOSED UPON

ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

# CONFIDENTIAL

# AD 3/6 982

**CLASSIFICATION CHANGED** 

TO: CONFIDENTIAL\_

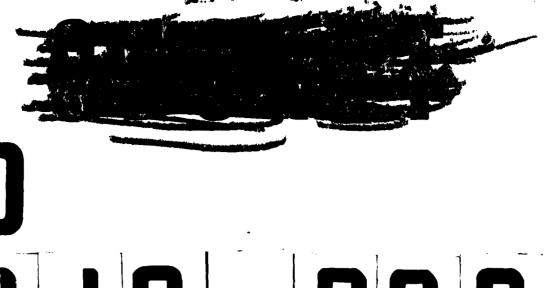
FROM: UNCLASSIFIED

**AUTHORITY:** 

1tr, 16 MAR 81



CONFIDENTIAL

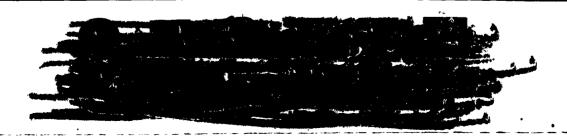


# 316382

# Reproduced by Armed Services Technical Information Agency

ARLINGTON HALL STATION; ARLINGTON 12 VIRGINIA

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.



# Development and Proof Services

REFERENCE COPY

REPORT NO. DPS/TN2-8051/1

INFANTRY AND AIRCRAFT WEAPONS DIVISION

REPORT ON

FRAGMENTATION OF PROJECTILE, ATOMIC, 279-MM, PRACTICE, SPOTTING, XM390, COMPOSITION B LOADED (C)

First Report on Ordnance Project No. TN2-8051

(D. A. Project No. 512-15-018)

#### LOAN COPY

RETURN IN 90 DAYS TO

#### ASTIA

ARLINGTON HALL STATION ARLINGTON 12, VIRGINIA

Attn: TISSS

J. T. DEMPSEY

**MAY 1960** 

FILE COPY

RLINGTON HALL STATION

ARLINGTON 12, VIRGINIA

Aberdeen proving ground

Maryland

# Best Available Copy

# DEVELOPMENT AND PROOF SERVICES ABERDEEN PROVING GROUND MARYLAND

AUTHORITY: ORDBB-TE5

JTDempsey/ma/41155

PRIORITY: 1A

FRAGMENTATION OF PROJECTILE, ATOMIC, 279-MM, PRACTICE,

SPOTTING, XM390, COMPOSITION B LOADED (C)

First Report on Ordnance Project No. TN2-8051

Dates of Test: December 1959 to April 1960

#### ABSTRACT (S)

Three Projectile, Atomic, 279-mm, Practice, Spotting, XM390, Composition B loaded were fragmented to evaluate fragmentation characteristics. The test results indicate that the projectile produced an average of 69,137 steel fragments with an average weight of 2.74 grains, and an average of 15,191 aluminum fragments with an average weight of 3.28 grains, with a mean velocity of 4876 feet per second. Seventy per cent of the steel fragments, and sixty-six per cent of the aluminum fragments were in the weight interval of 0 to 1 grain.

In view of the high percentage of small fragments (0 to 1 grain) produced by the pearlitic malleable iron warhead, further study should be conducted regarding the use of another explosive filler. Since the brisance of TNT is less than that of composition B, it is recommended that this warhead be tested using TNT as an explosive filler.

Engle to an undersorized person is prohibited by law."

#### CONTENTS (U)

	PAGE
INTRODUCTION	, 3
DESCRIPTION OF MATERIEL	. 3
DETAILS OF TEST	. 4
Facilities	. 4
Procedure	, 8
Analysis of Data	41
CONCLUSIONS	. 46
RECOMMENDATIONS	. 46
REF RENCES	47
APPENDIX A: CORRESPONDENCE	. A-1
APPENDIX B: ANALYTICAL LABORATORY REPORT	B-1
APPENDIX C: DISTRIBUTION	. C-1

#### ANNEX

EDVAC CODES

AMMUNITION DATA CARDS

(The Armex is on file in the Technical Library, APG for reference purposes. Copies of the Armex may be furnished to recipients of this report upon request.)

#### 1. (U) INTRODUCTION

The Feltman Research and Engineering Laboratories of Picatinny Arsenal requested that complete fragmentation data be obtained for the Projectile, Atomic, 279-mm, Practice, Spotting, XM390, incorporating warheads of pearlitic malleable iron that have undergone heat-treatment conditions to have a 50,000 psi minimum yield.

#### 2. (S) DESCRIPTION OF MATERIEL

The Projectile, Atomic, 279-mm, Practice, Spotting, XM390, consists of the following components:

- a. Body A thin-walled shell, 14.84 inches long and varying from 11.03 inches to 4.70 inches in diameter by following a 100-inch radius curve, and machined from 75ST6 aluminum forging (DWG AA-44-931, Reference 1).
- b. Antenna A dummy antenna for training, aerodynamics, and moment-matching purposes; machined from steel bar stock ClOlO; 6.66 inches long and varying from 4.14 inches to 2.25 inches in diameter. The antenna also forms a part of the gas seal to keep propellent gases from entering the rear body (DWG AA-44-898, Reference 1).
- c. Support, casing Used to mount the HE warhead and consists of a ring 10.46 inclues in diameter with a boss for transmission of set-back from the rear body. The support has eight mounting lugs which when mated with the lugs on the warhead transmit the warhead launching accelerations to the body (DWG AA-44-899, Reference 1).
- d. Windshield Fibrous glass mats for reinforcing plastics, and resin, low pressure, laminating, type I, specification MIL-R-7575 (DWG AA-44-897, Reference 1).
- e. Warhead Assembly A pearlitic malleable iron ball with 8.96-inch outside diameter and 8.11-in.h inside diameter. The warheads were subjected to a heat-treatment process that gave a minimum yield of 50,000 psi. Each warhead was loaded with 16.33 pounds of composition B explosive (Ammunition Lot No. PA-E-30299; DWG AA-44-918, Reference 2).

The projectiles used for fragmentation testing were incomplete and did not include the fin, shroud, setting dial, option switch, and tactical fuze.

The following materiel was used in this test:

a. Three body assemblies for Projectile, Atomic, 279-mm, Practice, Spotting, XM390 for fragmentation tests only, ammunition Lot No. PA-E-30478.

- b. Three pearlitic malleable iron warheads for projectile, ANGLO, ammunition Lot No. PA-E-30299.
- c. Three Fuzes, PD, M51A5, modified for static firing, no lot number.
- d. Three Blasting Caps, Electric, Type II.

#### 3. DETAILS OF TEST

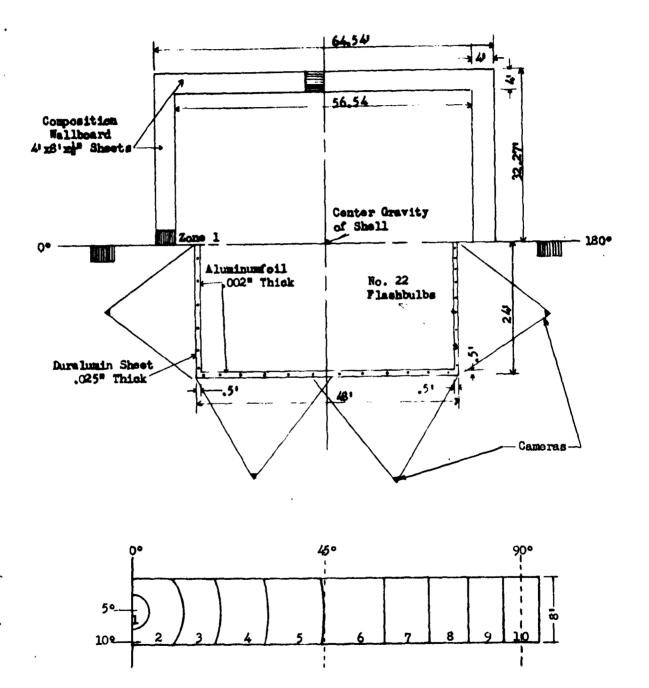
#### 3.1 (U) Facilities

A rectangular arena arranged around the ammunition was used for the fragmentation test. The arena was divided into a recovery-surface area of  $180^{\circ}$  and a velocity-target area of  $180^{\circ}$ .

The fragment-recovery area consisted of a wooden structure containing 4- by 8-foot by 1/2-inch sheets of composition wallboard placed upright to a depth of 4 feet. This wallboard was a fided this 10° zones: annular zones from 0° to 45° and 135° to 180°; we the answer from 45° to 135° (zone 1, 0° to 5°; zone 2, 5° to 15°; zone 3. 10° to 3° cone 10° gure 1). The perpendicular distance from the center of gravity of the projectile to the composition wall-board at 0°, 90°, and 180° was 20.27 feet (see Figure 1). In addition, two boxes, 4 by 8 by 3 feet in depth, were filled with composition wallboard and placed outside of the test arena. One was placed at the nose end or 0°, and the other at the base end or 180°, both 35 feet from the center of the test setup. These recovery boxes were used to obtain additional data from the nose and base fragments. This was accomplished by subtending the arc of both zone 1 on the nose box and zone 19 on the base box, making it possible to recover a better sample of fragments that had penetrated the wallboard in these two zones. Figures 1, 2, and 3 show a plan view and photographs of a typical fragmentation test setup.

Two 180° vertical walls, 8 feet high and 6 inches apart, with vertical supports placed at 4-foot intervals, comprised the fragment-velocity setup. The outer wall contained 24 sheets of duralumin, each 4 by 8 feet by 0.020 inch thick with the outside surface painted black, and gridded into 2-foot horizontal sections and 19 zones vertically, corresponding with the zones gridded on the wallboard. Figures 4 and 5 show velocity target gridding. The perpendicular distance from the center of the ammunition to the duralumin at 00, 900, and 1800 was 24 feet. The inner wall of the setup was composed of 0.002-inch aluminum foil used as a reflector for the number 22 flashbulbs which were placed at intervals between the walls (nine bulbs for each 4- by 8-foot target area). These flashbulbs were timed to reach their maximum brilliance when the fragments perforated the velocity targets. Flashbulbs were also placed around the outside of the arena to illuminate the velocity targets so that a record of the gridding would be visible on the high-speed film. The flashbulb function was synchronized by means of an electric sequence timer which assured that the outside bulbs would be out before the fragments struck the velocity targets.

#### PLAN VIEW OF TEST SETUP



ZONING OF RECOVERY AND VELOCITY TARGETS

Figure 1.

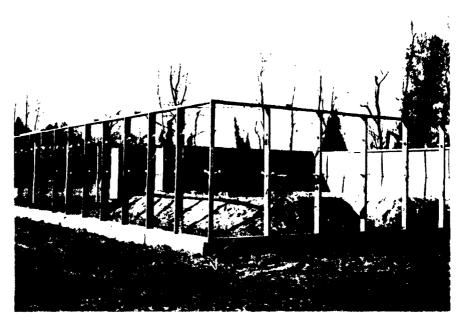


Figure 2 - S13-001-1385-7-1T/ORD-60: Typical View of Test Setup, Showing Zoning for Fragment Recovery.

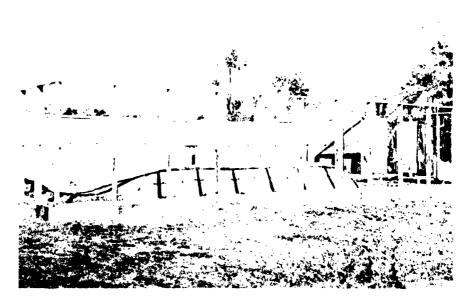


Figure 3 - S18-001-1385-7-2T/ORD-60: Typical View of Test Setup, Showing Various Stages of Completion.

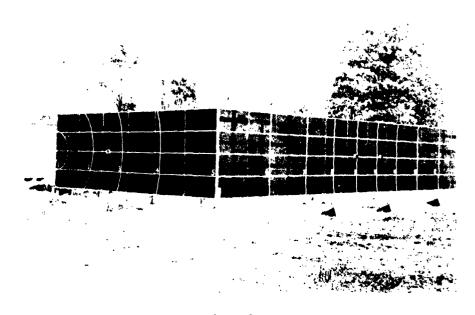


Figure 4 - \$18-001-1385-7-4T/ORD-60: General View of Velocity Targets Showing Gridding.

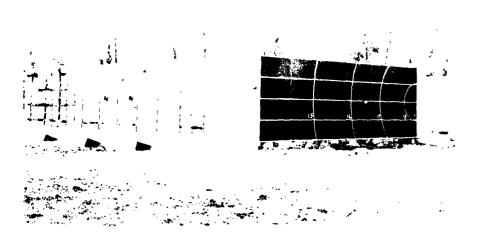


Figure 5 - S18-001-1385-7-3T/ORD-60: General View of Velocity Targets, Showing Gridding.

In order to obtain additional information on velocity levels of the steel and aluminum fragments, two recovery boxes, each 8 by 4 by 3 feet in depth, filled with composition wallboard and faced with a sheet of 0.020-inch duralumin painted black, were placed on top of the recovery setup, one at 45° and the other 135° from the nose of the projectile. These velocity-recovery boxes were used to correlate the recovered fragments with their respective velocities for Round 3 only. However, insufficient data were obtained to add any information regarding distribution (see Analytical Laboratory Report, Appendix B).

Four high-speed motion-picture cameras operating at a speed of approximately 10,000 frames per second and equipped with frequency standards and electronic timing devices were positioned around the targets to photograph both the detonation of the projectile and the impact of fragments on the velocity targets. To record the instant of detonation for zero time, the cameras were focused on the shell through the viewing holes in the velocity targets. Views of the flashbulb reflectors and cardboard cylinders in position are shown in Figures 4 and 5.

OPM 80-16, Volume IV contains further details of flashbulb installation and velocity measurement technique.

A richochet stop was provided for both the recovery area and the velocity targets to prevent fragments that struck the ground from ricocheting into the recovery or velocity panels. OPM 70-90, Volume I, contains other details on fragmentation procedure.

#### 3.2 Procedure

(U) The projectile and component parts were weighed and the recorded weights are shown in Table I.

Wable I (S). Projectile, Atomic, 279-mm, Practice, Spotting, XM390, Lot No. PA-E-30478

Round No.	Warhead No.	Weight Warhead Metal Parts, 1b	Weight Antenna Assembly, lb8	Weight Fuze M51A5 (Mod), 1b	Weight Explosive Composition B, lb	Weight Casing Support and Body lba	Weight Windshield, lb <sup>a</sup>
1	PA-64-59	27.60	5.85	1.50	16.63	10.73	5.92
2	PA-65-59	27.53	5.85	1.52	16.47	10.73	5.92
3	PA-66-59	27.53	5.85	1.50	16.67	10.73	5.92

<sup>&</sup>lt;sup>a</sup>Nominal weights, data supplied by Picatinny Arsenal (see correspondence, Appendix A).

(U) Each projectile was assembled with Fuze, PD, M51A5, modified for static firing, and placed individually on a wooden pedestal at the center of the setup. The pedestal was constructed so that the horizontal centerline of the projectile corresponded with the horizontal centerline of both the recovery boxes and velocity targets. The nose of each projectile pointed toward the

edges of the composition wallboard and velocity targets at 0°. The projectile was detonated by using a blasting cap, electric, type II initiated by a 110-volt power source.

- (U) After detonation of each projectile, a plot of the position of each hit in the duralumin targets was recorded on graph paper and correlated with the image of hits obtained on the high-speed film. The individual fragment velocity was computed from the known distance of the shell to the target, and the known fragment travel time obtained from the high-speed film.
- (U) The fragments that impacted in the wallboard were located by using an electronic metal detector. They were then recovered, identified as to zone, cleaned, weighed, separated according to type of metal (steel or aluminum), and segregated into weight intervals.
- (U) A sample of the recovered fragments, identified by zone and weight groups, is shown in Figures 6 and 7.
- (U) Tables II, III, and IV identify the fragments by zone number, weight, and type of metal for each weight interval.

Figure 6 - S18-001-1385-7-6T/ORD-60 (S): Recovered Fragments of Projectile, 279-mm, XM390, Composition B Loaded, Zones 1 to 11.

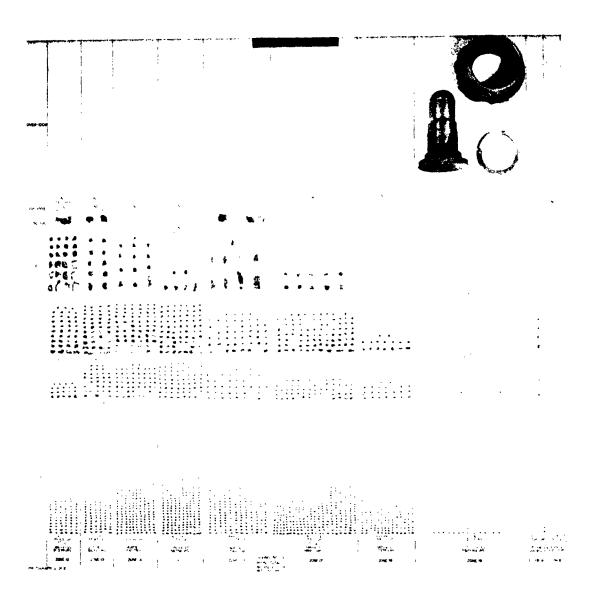


Figure 7 - S18-OO1-1385-7-5T/ORD-60 (S): Recovered Fragments of Projectile, 279-mm, XM390, Composition B Loaded, Zones 12 to 19.

**SECRET** 

Table II (S). FRAGMENT RECOVERY

National	TYPE: 279-mm, XM3	i, XM35	90				DATE FIRED:		30 December	r 1959	PRO PRO	ROUND NO.:	н
National Lange   Proceedings from wareen and process		positi											
Matchesist   Mat	S				[ <del>*</del> 4	RAGMENTS	FROM WA	RHEAD					
Thristian         No. $2 \text{ cme}$ Zone $2 \text{ cme}$ Zone $2 \text{ cme}$ Zone $2 \text{ cme}$ Zone $2 \text{ cme}$	URT (38P)			DISTRI			BY		D WEIGHT				
0 - 1   Mo. 27   164   115   34   40   45   45   45   45   45   45   4	INTERVALS IN GRAIN		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 3	Zone	Zone 10	Zone 11
1 - 2   NT.   22.6   47.45   30.50   15.07   10.42   15.06   5.63   13.35   55.40   15.13     2 - 5   NT.   20.40   37.20   23.22   27.1   14.73   1.21   2.63   11.05   64.40   11.05     3 - 5   NT.   20.40   37.20   17.34   36.00   12.25   37.20   13.05   12.20   444   7.5     5 - 6   NT.   20.40   37.30   17.34   36.00   12.25   36.20   36.20   14.65     6 - 10   NT.   26.65   39.16   46.40   25.52   35.20   43.60   12.22   32.43   63.60   20.20     6 - 10   NT.   26.65   39.16   46.40   25.52   35.20   43.60   12.22   32.43   63.60   20.20     7 - 20   NT.   26.65   39.16   46.40   25.52   35.20   43.60   12.22   32.43   63.60   20.20     15 - 20   NT.   26.65   39.14   70.00   129.35   17.62   13.75   32.94     15 - 20   NT.   26.55   39.14   70.00   129.35   17.62   13.75   32.94     15 - 20   NT.   33.30   33.20   30.51   17.62   13.75   32.94     15 - 20   NT.   33.30   30.20   70.15   120.23   31.00   31.00     25 - 35   NT.   33.30   30.21   70.25   20.15   11.25   23.10   64.00   23.40     26 - 70   NT.   26.60   120.00   25.60   101.50   112.32   31.05     27 - 80   NT.   59.60   100.00   55.60   101.50   112.32   31.05     28 - 90   NT.   NT.   26.60   100.00   25.60   101.50   112.25   31.00     29 - 100   NT.   100   120.00   120.00   120.00     20 - 100   NT.   100   120.00   120.00   120.00     20 - 100   NT.   100.00   120.00   120.00     20 - 100   NT.   100.00   120.00		M	Lć	164	115	ਨੰ	017	61	4.5	947	277	69	24
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	ı	H	55.55	47.45	30.50	19.67	10.42	15.06	5.63	13.35	35.40	18.13	7.04
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	١	NO.	17	92	15	77	0	7	2	Ĺ	1	5	4
2 - 5         NO.         13         24         10         11         4         6         11         4         6         12         5         16         40         17         4         6         6         10         17         4         6         6         11         4         6         6         11         7         2         2         11         3         10         1         4         6         6         11         2         2         12         2         12         2         11         3         3         10	- [		20.40 20.40	37.50	23.22	9.77	14:73	1.21	2.63	7.60	- 1	11.05	6.37
5 - 8         NG.         17.97         37.00         17.34         36.00         12.37         20.21         36.00         13.00         13.00         12.37         20.21         36.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         13.00         20.50         13.00         1	•	<u>.</u>	13	72	2		7	# !	٥	21	יו	- 6	7
5 - 8		I.M	<u>က</u>	31.97	37.00	17	8.6	12.35	20.21	8 8 0	- 1	20.62	27.00
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	ı	2	*		2	1			- 1	6,1 00		2	10
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		NO.	9,0	30.10	46.40	75.52	22.02		1	۲. ا	ı	3	† †
10 - 15   No.   1	) )	1	15.60	14.27	26.72	61.74	1	1	୍ଦ	8.60	1		35.60
- 17	٤	NO.	1	ro	Ω			3	(1)		Į :	-	3
20         NO.         32.14         70.00         132.35         17.62         19.75         32.24         65.30         31.05           NO.         NO.         1         2         4         2         1         2         4         2         1         2         4         2         1         2         4         2         1         3	ı	E.	12.53	94.55	75.74	L	61.00	35.20	33.00	13.10		12.57	40.54
25         WT.         32.14         70.00         132.35         17.62         19.75         32.24         65.00         31.00           80.         NO.         4         2         4         4         2         1         3         31.00         31.00           35         NO.         1         3         3         3         3         3         3         1         2         1         3         2         2         2         1         3         3         3         3         3         3         3         3         3         3         3         3         1         2         1         2         1         2         1         2         1         2         1         2         1         2         1         2         3		S		a	7	ω	H	7	2		4	2	3
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	•	MT.		32.14	70.00	132.3	17.62	13.75	32.24		65.30	31.0€	46.20
47.         WT.         34.40         41.35         32.69         59.18         41.20         23.50         67.00         2           35.         MO.         1         3         3         3         3         3         3         1         2         1         2         1         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         3		NO.		†	2	†7			2	1	3		٦
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	•	WT.		0 <del>1</del> .40	41.33	ેટ.6	1		41.20	23.50			22.30
9.7         WT.         33.30         93.20         30.51         75.25         26.65         54.00         34.46         64.00         55.62           NO.         WT.         79.62         172.20         135.42         35.04         40.00         122.32         37.13         109.20         91.62         13.50           NO.         NO.         1         2         2         1         2         2         1         3         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         1         3.50         3.5	١	NO.	T	3	3	3		ı	a	-1	- 1	2	2
50         NO.         2         4         3         1         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         2         1         3         1         3         1         3         2         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3         1         3	•	.IM	33.30	93.20	30.51	75.25		26.€	24.00	O∓.‡5	- 1	5>.62	54.10
WT.         VF.62         172.25         135.42         35.04         40.00         122.32         37.13         109.20         91.62         43.50           WT.         No.         1         2         2         1         2         2         1         35.60         91.62         43.50           No.         WT.         59.60         100.03         55.60         52.30         101.55         112.52         53.60         1		NO.	2	17	m	r-1			-1	~	2	7	
60         NO.         1         2         1         2         1         2         1         2         1         2         1         2         1		Ę,	79.62	172.2	135.42	35.04		- 1	30.18	109.20	91.62	43.80	
WT.         59.60         100.03         55.60         52.30         101.52         123.50         133.50         1	1	NO.	1	2	М			a	7				
- 70         NO.         1         2 <th>ı</th> <th>MT.</th> <td>59.60</td> <td>100.03</td> <td>55.60</td> <td></td> <td>ļ</td> <td>112.52</td> <td>53.60</td> <td></td> <td></td> <td></td> <td></td>	ı	MT.	59.60	100.03	55.60		ļ	112.52	53.60				
- 80 WT. 65.40 66.00 63.20 61.00 61.20 63.20 -	1	NO.			1		Н		7	7	1	7	
- 80 WT. 15.72 1 1 15.72 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ı [	¥.			65.40		8.99		63.20	0.18	61.20	8	
- 30 WT. 1 75.72 - 15.		NO.									1		7
- 90 WT. 35.00 2 - 100 WT. 35.00 2 - 100 WT. 134.00 91	•	WT.									75.72		℃ 200
- 30 WT. 35.00 2 - 100 WT. 2 134.00 31	ĺ	NO.							1				
- 100 NT. 2 2 31 134.00 91	• [	LT.							35.00				
	1	NO.								2	-		
	İ	L								10t-18	티		

ORDBG Form 1490, Rev 21 Mar 60

SECRET

TYPE: 275-m. 3013-0	X13	Q				DATE FIRED:		30 December 1959	er 1959	RO	ROLLIND NO.:	1
FILIER: Com	Compositi	ion E										
മ				FF	FRAGMENTS	FROM WARTELD	THEAD	:				
WETCHT			DISTRIBUTION	SUTTION OF		FRACENTS BY NUMBER AND WEIGHT	JABER ANI	WEIGHT				
INTERVALS IN GRAIN		Zone 1	Zone 2	Zone 3	Zone lt	Zone 5	Zone 6	Sone '	Zone G	Σone €	Zone 10	Zone 11
	NO.								1			
100 - 125	Ĭ.		100.00						102.00			
125 - 150	2								7			
-	M.I.		120.00						137.00			,
150 - 200	Ę								172.00			156.00
	NO.											
200 - 250	.I.v.											
r C	NO.											
550 - 300	M.I.											
0	NO.											
300 - 400	EM.											
00° = 004	2											
١.	E.									ŀ		
50C - 750	1											
	W.T.		-									
750 - 1000	2 5		7 0.7									
	NO.	-1	3									
1000and Over	Ĭ.	5043.00										
	NO.											
	M											
	NO.											
	5											
	NO.											
	Ę											
	2											
			0.0		1	ľ	í		-	5	į	5
Total		2.70	676	777	777	אָר בּיַר בּיַר		1.00		40T	1	76
	W.T.	1	15.44.S	630.03	56.04	401.21	#0./.01	477.00	732.43	. S.	200.	24.50
מסיור בבים המתפת	5	197	4									

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

TYPE: 279-mm,	m, XM390	Q				DATE FIRED:	1	30 Dccember 1959	r 1959	ROUN	ROUND NO.:	1
FILIER: CO	Composition	on B										
S				FR	AGMENTS	FRACMENTS FROM WARHEAD	HEAD					
THEOLOGIC			DISTRIB	UTION O	F FRACME	DISTRIBUTION OF FRACMENTS BY NUMBER		AND WEIGHT				
INTERVALS IN GRAIN		Zone 12	Zone 13	Zone 14	Zone 15	2 <b>one</b> 16	Zone 17	Zone 13	Zone 13	F.	Total No.	Totel Weight
	<b>1</b> 0.	Ž	ζú	114	ે/દે	5.04	305	77/0	391		4065	
7 - 0	WT.	19.77	25.36	31.64	35.70	112.60	121.50	94.40	37.44			322.75
6 - [	₩	ro	16	ŝ	36	52	92	1.5	10		331	
• }	Ę.	13.35	24.95	41.40	50.30	71.00	37.40	20.63	13.23			476.36
	NO.	12	19	31	33	45	23	9	્		324	
c = 2	WT.	34.65	59.30	93.40	122.60	140.00	71.34	13.02	15.63			016.13
	NO.	7	3	14	10	9	11	2			1114	
o <b>-</b> 0	.T.	ि.मे	19.55	ઝ૯.૦૦	56.20	37.04	72.ो₄	12.53				706.12
0 5	Ñ.	۲۱		ω	1	1	5				712	
١	Ę,	8.35		ુ 8	9.23	9.46	45.20					404.39
בי בי בי	NO.	5	3	-7	4	4	9				3	
2	Ę	60.34	33.40	45.12	50.do	98.34	06.70				╗	020.95
ה ה ה	S	i,	C)	3		1	1				33	
٠ }	Š	00.24 00.24	33.30	53.40		15.13	15.35				-	654.13
5	NO.	2					3				જ્	
(2 <b>-</b> (2)	WT.	76.30					68.30					567.65
	NO.	17	2	].		2					્ટ	
67 - 37	MI.	114.40	53.30	27.18		65.60						339.54
-	NO.	1	1								23	
25 - 55	WT.	41.14	1,1.4c								П	:51.32
	NO.	1									11	
30 - 20	E.M.	53.84										589.62
02	NO.										9	
•	¥.											35.00
70	NO.										3	
· ]	Į.						%ે.				╗	232.32
S	<u>چ</u>										r-1	
•	WT.											ં5.00
(C)	MO.									_	3	
•	M.I.											275.20
	֓֞֝֟֝֟֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֟֜֟֓֓֓֓֓֓֓֡֓֓֓֓֡֓֡֓֡֓֡											

OKUBG Form 1490, Rev 21 Mar 60

**SECRET** 

325.00 54105.53 202.00 00.00T 406.72 43543.00 Weight Total ROUND NO.: Total 518 **C1** C1 Q1 S-500.00 772 7.3 1.55 723.75 140.53 30566.36 30 December 1959 Zone DISTRIBUTION OF FRACTENTS BY NULBER AND WEIGHT Zone 141.72 Zone 17 DATE FIRED: FRACMENTS FROM WARREAD 635 450.74 2one 16 ±65 3≅9-33 Zone 15 204 446.14 2one 14130 292.66 Zone 100 524.64 Zone 12 ρĄ Composition 279-m, XM390 MO. WIT. NO. 1000 and Cver WEIGHT INTERVALS IN GRAIN 1000 - 150 - 200 - 250 8 90<del>1</del> -- 500 - 750 100 - 125 TILIER: ı TYPE: Total 28 750 150 88 250 8 3 125

ORDBG Form 1490, Rev 21 Mar 60

**SECRET** 

24.50 3.33 2.33 2 11.86 15.65 **Zone** 13 ROUND NO.: 8.8 23.72 ે.જ 20.17 8 8 Zone 17 12.20 11 136.40 3.52 24.43 51.80 16.15 35.8 152 Zone 16 1 8 TI 38.8c 25.40 16.42 30.40 72.66 19.37 25.94 30 December 1959 Zone 15 DISTRIBUTION OF FRACMENTS BY NUMBER AND WEIGHT 13.70 13.61 12.45 3.65 27.02  $_{14}^{\rm Zone}$ FRACMENTS FROM OUTER CASE (ALLIALINUM) 7.23 33.00 2 8.89 8.80 36.00 25.55 Zone 13 20.77 DATE FIRED: 35.00 10.02 16.32 5.03 2,8 6.15 2 56.60 20**ne** 12 19.92 90.72 149.64 2 57.00 22.00 4.12 19.35 9.05 38.30 39 20.95 1.27 Zone 11 16.05 7.02 31.60 43.03 2).80 20 20 16.30 36.60 33.10 Zone 10 3.9 10.19 67.32 77.53귀 6.50 **2.**39 92.06 7.85 3.27 9 **Zone** 9 Composition B 279-mm, XM350 WEIGHT INTERVALS IN GRAIN - 100 - 15 <u>و</u> 8 ဌ ႙ 25 33 S ઉ න • Н Q Ś ထ FILLER: ı 1 . ı 1 ı TIES: З 5 52 35 ß જ 2 8 0 -1 Q Ś ထ ଯ တ္တ

ORDBG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

National	TYPE: 279-0	279-mm, XM390	8				DATE FIRED:	1	30 December 1959	r 1959	OH.	ROUND NO.:	1
NET CRAN LIST   DISTRIBUTION OF FRAGRENTS BY NUMBER AND METGHT   LIST		omposît;	g										
NET CHANGE   LINE STANDARD			٠		FRACIMENT	S FROM C	UTER CAS	E (ALUMI	иом)				
National Parameter   Nationa	WEI CHIT			DISTRI	BUTTON	F FRAGM	TALL BY I	TUMBER AN	D WEIGH				
100 - 125	INTERVALS IN GRAIN			Zone 9	Zone 10	Zone 11	Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18
125 - 150   WT.   Recovery   Rough		MO.	No										
125 - 150 MO. Recovery	1	WT.											
150 - 200   WT.   1n		M	Recovery										
150 - 200 MO. 111  200 - 250 MO. 20nes  250 - 300 MT. 2  300 - 400 MT. 3  300 - 400 MT. 5  400 - 500 MT. 5  500 - 750 MT. 6  500 - 750 MT. 6  1000 and Over MT. 9  1000 and Over MT. 1000 MT. 1100 MT. 11													
250 - 250	ı	2	ln										
250 - 250         MO.         Zones         Rock         Cones         Rock		E											
250 - 300	1	10	Zone s										
250 - 300 MO. 2		MT.	٦.										
300 - 400         WT.         3         9 <th< th=""><th>ı</th><th>10</th><th>2</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th<>	ı	10	2										
300 - 400		WT.	3										
4NT.         5         N.T.         6         N.T.         7         N.T.         7         N.T.         9         N.T.         9         N.T.         9         N.T.         N.T. <t< th=""><th>900</th><th>19</th><th>†</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>	900	19	†										
- 500 NO. 6	,	WT.	5										
- 750 NO.	•	NO.	9										
- 750 NO. 8		Ĭ.	7										
- 1000 NO. and Over NO.		10	8										
-,1000 NO.		Ĭ.											
wr.         wr.         NO.         NO. <th>750 - 1000</th> <th>MO.</th> <th></th>	750 - 1000	MO.											
and Over         NO.         NO		Ę											
WT.         NO.         NO. <th>1000 and Ove</th> <th></th>	1000 and Ove												
NO.   NO.													
WT.   NT.		ç E											
MT.		Į.											
WT.		₽											
MO.         F.		VI.											
WT.         31         32         45         131         189         168           WT.         15         37         31         38         53         45         131         189         168           WT.         116.27         425.06         288.54         396.66         151.32         78.09         263.79         445.64         94.69		NO.											
MT.         31         31         38         53         45         131         189         168           MT.         116.27         425.06         288.54         396.66         151.32         78.09         263.79         445.64         94.69		WT.											
WT.     15     37     31     38     53     45     131     189     168       WT.     116.27     425.06     288.54     396.66     151.32     78.09     263.79     445.64     94.69		130											
MO.         15         37         31         38         53         45         131         189         168           WT.         116.27         425.06         288.54         396.66         151.32         78.09         263.79         445.64         94.69		Ę											
WI:   116.27   425.06   288.54   396.66   151.32   78.09   263.79 445.64   94.69	Tutel	NO.		15	37	31	38	53	45	131	189	168	98
	100.01	Ę.		116.27	425.06	288.54	39.96	151.32	78.09	263.79	45.64	_	148.67

ORDBG Form 1490, Rev 21 Mar 60

SECRET

FRAGMENT RECOVERY

TYPE: 279-mm,	m, XM390	350	DATE FIRED: 30 December 1959	ROUND NO.: 1	
FILTER: Com	Compositi	on B			
A			FRAGMENTS FROM OUTER CASE (ALLMINUM)		
VEIGHT			DISTRIBUTION OF FRACKENTS BY NUMBER AND WEIGHTS		
INTERVALS IN GRAIN		<b>Zone</b> 19		Total To	Total Weight
	MO.	п		109	
T - 0	WT.	2.36			154.90
1 - 2	ĬO.	1		53	İ
۱ ۱	Ė	1.49			75.58
ر ا ا	<u>.</u>	-*		力	
۱ ۱	5	11.75			179.49
cc tr	Ģ.			27	
·	Ę	٠			169.06
2	£ €			13	
۱ ۱	Š				115.42
אר ה טר	19			य	
۱ ۱	M				142.43
15 . 20	E			7	
۱ ۱	.I.				118.9 8.0
20 1 05	Q			6	
١ ١	Š			8	다. 한
25 - 35	MO.			10	
۱ ۱	Š				289.43
35 - 50	MO.			टा	
)	W.			946	495.86
20 - 60	MO.			1 1	
١	Į.			5	51.80
02.	<b>3</b> 0.			1 1	
•	W.			9	67.82
70 PS	MO.			1	
۱					77.58
8	10				
۱ ۱	Į.				
00 - 06	9		•	2	
- 1	W.I.			2	181.18
					ļ

ORDBG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

					4.0								
PILIZER: Composition B   FRAGMENTS FROM OUTER CASE (ALIMITION)			, XXX39	0			DATE FIR	ಜ್ಞ	December 1	959	SE SE	ND NO.:	- 1
National   National		FILLER: Com	positi	d									
National Part   1975	L				FRACMENTS	FROM OUT	TER CASE	(ALUMIN	UM)				
INTERNALIS         Zone         Total           100 - 125         NO.	Ц	VRT (SAT)			DISTRIBUTION OF		BY	IBER AND	WEIGHTS				
125 - 150 NO. NO. NO. NO. NO. NO. NO. NO. NO. NO.		INTERNALS IN GRAIN		<b>Zone</b> 19									Total Weight
125 - 150 NO. NO. NO. NO. NO. NO. NO. NO. NO. NO.	ш		IIIO										
150 - 200			NO.										
150 - 200   WT.		.	MT.										
250 - 250 NO. NO. NO. NO. NO. NO. NO. NO. NO. NO.	-	ı											
250 - 300   WT.	<u>.                                    </u>		.01							+			
250 - 300   WT.		Ì	T.M.							1			
NO.         NO. <th>L8</th> <td>ı</td> <th>MT.</th> <td></td>	L8	ı	MT.										
WT.         NO.         NO. <th>Щ.</th> <th></th> <th>NO.</th> <th></th>	Щ.		NO.										
WO.         W.T.         NO.         NO. <th></th> <td>•  </td> <th>E.</th> <td></td>		•	E.										
WT.         NO.         1 <th></th> <th>1</th> <th>9</th> <th></th> <th></th> <th></th> <th>1</th> <th></th> <th></th> <th>+</th> <th></th> <th></th> <th></th>		1	9				1			+			
WT.         NT.         1           WT.         1         1           WT.         18900.06         1           WT.         1         2           WT.         2         3           WT.         3         3           WT.         3         3 <tr< td=""><th></th><td>1</td><th>ï</th><td></td><td></td><td></td><td>1</td><td></td><td></td><td></td><td>1</td><td></td><td></td></tr<>		1	ï				1				1		
NO.         1	_	ŧ											
WT.         1	_	350	MO.										
NO.   1   1   1   1   1   1   1   1   1	_	MT - M	WT.							1			
WT. 18900.00 WT. WT. WT. WT. WT. WT. WT. WT. WT. WT.		OOO and Over		_								7	
WT. WT. WT. WT. WT. WT. WT. WT. WT. WT.			_	۹.		1				$\dagger$			07m.m
WT.         WT.         NO.         NO. <th></th> <td></td> <th>Ė</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td>			Ė							-			
WT.         W.         NO.	Т		MO.										
MO.         NO.         NO. <th></th> <td></td> <th>W.</th> <td></td>			W.										
WT. 18915.6q 810	Щ.		NO.										
MT. 18915.6q 810			WT.							1			
WT. 18915.6d 810	<u> </u>		MO.			_							
Mr. 18915.6d 810			į.									,	
WT: 13915.6q		-	<u>.</u>	77						-			
		Total		18915.60						-			1224.33

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

Matter   Composition   B   Fractorial Structures   F	TYPE: 279-mm,	ma, xxx390	8				DATE FIRED:		30 December	r 1959	ROUN	ROUND NO.:	٦
NETGRIT   Statements from waretern decorated brown weights   Netgrit   Net	1	wpositic	g										
VETGET   Like		FRAG	MENTS FR	OM WARTE	AD RECOV	TERED FRO	M NOSE A	ND BASE	BOXES				
National Land   18	URTORN			DISTRI					D WEIGHT	ស			
The Gravita   The case   The ca	THIERWAIS		7,000	70m		7.one	7one			Total	Total	<u> </u>	Grand
0 - 1	IN GRAIN		N N	ន	Total	18B	138	Total		A Frags	S and F Frags	<u>- 7</u>	Total All Frage
0 - 1         WT.         9.18         29.20         36.36         12.90         32.96         154           1 - 2         MO.         6         14         20         6         16         22         75           2 - 5         WT.         8.82         21.55         30.37         7.49         23.02         30.51         75           2 - 5         WT.         23.90         33.04         56.94         9.42         8.41         17.83         179           5 - 8         WT.         6.60         24.83         31.43         169         169           8 - 10         WT.         16.67         8.32         24.99         169         115           10 - 15         WT.         52.00         23.09         75.09         116         118           20 - 25         WT.         80.         80.         80.         80.         80.         80.         80.           50 - 60         WT.         1 <th></th> <th>je je</th> <th>18</th> <th>11</th> <th>95</th> <th>57</th> <th>31</th> <th>88</th> <th></th> <th>209</th> <th>4065</th> <th></th> <th>4855</th>		je je	18	11	95	57	31	88		209	4065		4855
1 - 2         NO.         6         14         20         6         16         22           2 - 5         NT.         8.82         21.55         30.37         7.49         23.02         30.51         75           2 - 5         NT.         21.40         33.04         56.94         9.42         8.41         17.83         179           5 - 8         NT.         6.60         24.83         31.43         6.94         9.42         8.41         17.83         179           8 - 10         NT.         6.60         24.83         31.43         6.94         9.42         8.41         17.83         179           10 - 15         NT.         6.60         23.09         75.09         75.09         75.09         11.83           20 - 25         NT.         NT.         11.60         11.83         11.83         11.83           50 - 60         NT.         NT.         11.83         11.83         11.83         11.83           60 - 70         NT.         NT.         11.83         11.83         11.83         11.83           80 - 90         NT.         11.         11.         11.         11.83         11.83	ı	Ę	9.18	29.20	38.38	20.96	12.00	32.96		154.90	822.75	Ť	1048.99
1 - 2         WT.         8.82         21.55         30.37         7.49         23.02         30.51         75           2 - 5         WT.         23.90         33.04         56.94         9.42         8.41         17.83         179           5 - 8         WT.         6.60         24.83         31.43         8.41         17.83         179           8 - 10         WT.         6.60         24.83         31.43         8.42         16.9           10 - 15         WT.         52.00         23.09         75.09         9.5         9.5           10 - 15         WT.         52.00         23.09         75.09         9.5         9.5           20 - 25         WT.         80.         80.         9.5         9.5         9.5         9.5         9.5           50 - 60         WT.         70.         80.         9.60         9.00         9.00         9.00         9.00           80 - 90         WT.         99.00         99.00         99.00         99.00         99.00		10	9	17	8	9	16	22		53	331		<sub>4</sub> 26
2 - 5         NO.         8         11         19         3         3         6           5 - 8         NO.         23.90         33.04         56.94         9.42         8.41         17.83         179           5 - 8         NO.         2         1         3         4         159         159         179	1	Ş	8.82	21.55	30.37	7.49	23.02	30.51		75.58	96*92†1		613.42
2 - 5         WT.         23.90         33.04         56.94         9.42         8.41         17.83         179           5 - 8         WO.         2.60         24.83         31.43         1.69         1.69           8 - 10         WO.         2.60         24.83         31.43         1.69         1.69           10 - 15         WO.         1.60         2.60         23.09         75.09         1.15           10 - 15         WO.         1.00         1.00         1.00         1.15           20 - 25         WO.         1.00         1.00         1.18           20 - 25         WO.         1.00         1.00         1.00           25 - 35         WO.         1.00         1.00         1.00           35 - 50         WO.         1.00         1.00         1.00         1.00           60 - 70         WO.         1.00         1.00         1.00         1.00         1.00           80 - 90         WO.         1.00         1.00         1.00         1.00         1.00           90 - 100         WO.         1.00         1.00         1.00         1.00         1.00	ļ	MO.	8	נו	19	3	n	9			₹8		103
5 - 8       NO. 2       24.83       31.43       169         8 - 10       NO. 2       16.60       24.83       31.43       169       159       150         10 - 15       NO. 4       2       6       6       6       6       17.09       17.09       17.09         15 - 20       NO. 5       NO. 52.00       23.09       75.09       75.09       17.09       17.20         20 - 25       NO. 5       NO. 5       NO. 5       17.00       17.	ı	H.	23.90	33.04	16.9₫	9.45	8.41	17.83			1016.13	리	1270.39
5 - 8       WT.       6.60       24.83       31.43       159       159       159       175		E	ī	#	5						4114		<b>₽</b>
8 - 10       NO.       2       1       3       15       15       15       15       15       15       15       15       16       17       17       17       17       17       17       17       17       17       17       17       18       17       17       18       <		Ę	9.90	24.83	31.43					169.06	706.12		00°07
8 - 10       WT.       16.67       8.32       24.99       115         10 - 15       WT.       52.00       23.09       75.09       142         15 - 20       WT.       10.0       11.0       11.0         20 - 25       WT.       10.0       11.0       11.0         25 - 35       WT.       10.0       10.0       10.0       10.0         50 - 60       WT.       10.0 </th <th></th> <th>MO.</th> <td>2</td> <td>1</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td>13</td> <td>917</td> <td></td> <td>જી</td>		MO.	2	1	3					13	917		જી
10 - 15       W0.       4       2       6         15 - 20       W1.       52.00       23.09       75.09       138         20 - 25       W1.       M0.       2       6       204         25 - 35       W1.       M0.       2       204         50 - 60       W1.       1       1       495         60 - 70       W1.       79.80       79.80       77         80 - 90       W1.       1       1       1         90 - 100       W1.       1       1       1         W1.       1       1       1       1         90 - 100       W1.       1       1       1	ι ∞	M.	19.91	8.32	24.99					115.42	68.407		245.30
- 15 WT. 52.00 23.09 75.09 14.2  - 20 WT.		<b>€</b>	<b>†</b>	2	9					21	69		Q
- 20	ŧ	F.	52.00	23.09	75.09					142.43	828.95		1046.47
- 20	ı	M								7	39		ĝ
- 25	•	ij								118.94	654.18		773.12
- 25		NO.								6	જ્ઞ		3
- 35	ı	Ę								204.54	29.195		772.19
- 35 WT. 289  - 50 WT. 495  - 60 WT. 289  - 70 WT. 1 1 2  - 80 WT. 79.80 79.80  - 90 WT. 99.00 99.00 180	l	MO.								10	53		39
- 50 W	•	Ë								289.43	839.54	-	1128.97
- 50 WT. - 60 MT. - 70 WT. - 80 WT. - 90 WT. - 100 MT. - 100 WT. - 100 WT.		MO.								27			35
- 60 MO.	•	5								455.00	श्र	1	
- 70 MT. - 80 MT. 19.80 79.80 77.80 77.80 77.80 181.		2								1 5	11 68 683	+	21 112
- 70 WT. 1 1 1 67  - 80 WT. 79.80 79.80 77.80  - 90 WT. 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ı	T.								3	L		•
- 80 MO. 10. 10. 10. 10. 10. 10. 10. 10. 10. 10	1	2								67 63	385 OO		1,52.82
- 80 WT. 79.80 79.80 77.80 - 90 WT. 181 181		1		_	_					7	20.22		1
- 90 NO NO 1 181	ı		-	70 A	70 20					77.58	22,02	<del> </del>	210.50
- 90 WT. 1 1 1 1 181 181 181 181 181 181 181 18	١			2	22:21						1		-
- 100 MG. 1 1 1 181	ı	5									85.00		85.00
- 100 viii 99.00 99.00 181				_	-					C	L		2
	ı	Ę		00.00	00.00					181 18	275,20		156.68
										2 - 2 - 2			

OKODEG Form 1490, Rev 21 Mar 60

**SECRET** 

PILLER; Composition B   PILL	TYPE: 279-ma,	а, хивоо	8				DATE FIRED:		30 December 1959	ROUND NO.:	: 1
Frachemy Recovered Frachemy Base Boxes, (Noce - Fuze) (Base - Street)   Interest All Base Boxes   Interest All Base Boxe		mposit.	g								
Marche   Marche   March   Ma	ន	FRACM	ENTS REC	OVERED FI	ROM NOSE	AND BAST	BOXES,	ı	١	STEEL)	
	URT (SPI)			DISTRI			NTS BY N		WEIGHTS		
13   13   13   13   13   13   13   13	THERMAIS		Zone	auoz		Zone	Zone		Total		Grand
100 - 125	IN GRAIN		υT	ZN	Total	18B	19B	Total	Frags		AI1 Frags
125 - 150   WT.		<b>3</b> 0.								2	
125 - 150	1	WT.								202.00	202.00
150 - 200	(	<u>8</u>								3	3
150 - 200 MC	۱									406.72	406.72
200 - 250   NT.   288.00   288.00   288.00   288.00   280		<b>1</b> 0.							-	2	2
250 - 250 MO.		W.								328.00	328.00
250 - 300		HO.									
250 - 300	ı	Ę.									
200 - 300         WT.         Companies         Comp		MO.									
300 - 400 WT.	- מלא	WT.									
Fig.   Fig.	200	MO.									
- 500   NO.   NO	.	Į.									
1750   WT.	١.	<b>X</b> 0.									
1 - 750         No.		W.									
No.   No.		<b>M</b> 0.				Ī					
1000   WT.   100.00		MT.									
and Over Mr.         Wr.         1         2           And Over Mr.         Wr.         1         2           Mr.         1         2         2           Mr.         1         2         2           Mr.         1         2         3           Mr.         30         30         3         3         3           Mr.         30         30         3         3         3         3         3           Mr.         Mr.         30         31         3	l	E0								1	1 1
and Over         NO.         NO		WT.								790.00	790.00
MT.   MT.   MT.	74								-	4	3
W.C.									18900.00	_	62443.00
WT.         INO.		9									
W.T.         150.         39.         117.17         318.83         4.36.00         37.87         4.3.43         81.30         51.00           W.T.         117.17         318.83         4.36.00         37.87         4.3.43         81.30         51.00		ij									
WT.         BO.         BO. <th></th> <th><b>II</b>0</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>		<b>II</b> 0									
W.T.         150.         39         111         150         66         50         116         810         5100           W.F.         117.17         318.83         436.00         37.87         43.43         81.30         21224.33         54405.95		Į.									
W.F.         10.         150         66         50         116         810         5100           W.F.         117.17         318.83         436.00         37.87         43.43         81.30         21224.33         54405.95		10									
Wr.         39         111         150         66         50         116         810         5100           Wr.         117.17         318.83         436.00         37.87         43.43         81.30         21224.33         54405.95		W.									
WF.         39         111         150         66         50         116         810         5100           WF.         117.17         318.83         436.00         37.87         43.43         81.30         21224.33         54405.95		E									
WC.         39         111         150         66         50         116         810         5100           WF.         117.17         318.83         436.00         37.87         43.43         81.30         21224.33         54.05.95		5									
WT.   117.17   318.83   436.00   37.87   43.43   81.30   21224.33   54105.95	Intal	2	39	_1	150	8	2	116	810	5100	6176
			117.17		436.00	37.87	43.43	81.30	21224-33	54105.95	75247.58

ORDBG Form 1490, Rev 21 Mar 60

SECRET

32.44 58.34 55.52 46.60 63.20 35.70 70.03 27.65 Zone a ROUND NO.: 32.00 52.00 83.24 24.75 71.24 26.07 17.64 137.84 12 1,7 Zone 10 52.00 57.80 36.30 <del>छ. ।</del> 73.26 46.08 94.12 42.90 77.99 62.88 147.80 39.20 **Zone** 9 25.40 33.00 74.20 20 7.65 17.71 69. 17.44 8 2 Jenuary 1960 Zone 8 AND WEIGHTS 163.00 2 105.86 75.45 37.30 41.26 2 46.46 33.68 11.06 25.29 8.39 82.00 26.67 Zone 7 75 39.4d 15.52 49.0<del>1</del> 61.62 126.50 85.20 23 18.40 28.46 8.9 9.9 75.10 NUMBER Zone 6 DATE FIRED: FRACMENTS FROM WARHEAD 52.60 28.22 21.36 17.94 57.88 p2.99 2 87.00 70.24 10.41 5 FRACMENTS BY **Zone** 5 2 62.68 8 8 119.00 8.00 77.80 22.84 52.46 73.85 143.80 8 Zone ģ 38.57 141.82 40.20 45.20 42.44 <del>111.89</del> 54.17 130.6d 161.00 2.50 な DISTRIBUTION Zone 3 80.03 2 109.60 32.88 90.06 61.85 26.14 75.83 30.55 16 23.27 19 37.97 250 Zone 2 50.60 87.79 10 13.14 15 10.11 24.81 94.47 19.40 9 Zone 1 ф Composition XXXX 02 E MT. 일 달 279-111. WEIGHT INTERVALS IN GRAIN 200 8 - 15 20 જ 2 8 ឧ ପ୍ଷ 35 25 Н Q 5 ω TILLIER: . . 1 . ı 1 . TYPE: 8 જ 2 8 8 2 ଷ 35 0 Q Ś ω 15 8

(s)

Table III

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

STILER:   Composition   State   Stat	TYPE: 279-mm,	m, XP390	8				DATE FIRED:	1	12 January 1960	y 1960	8	ROUND NO.:	2
National State   1972		mposit											
National Part   Marche   Mar	S				E	RAGMENTS	FROM WA	RHEAD					
	LANCE LEGISTRA			DISTRI		F FRACME	NTS BY N	UMBER AN	ID WEIGHT	<b>153</b>			
125 - 150	INTERVALS IN GRAIN		Zone .	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
125 - 1250   WT.		ě.		1						1			
125 - 150 W	•	MT.		112.20						115.00			
150 - 200   NT.   202.00   202	١	) Si 5											
150 - 200   WT.	1	NO.											
200 - 250         NO.         1         202.00         1         209.00           250 - 300         NT.         202.00         0         209.00         0         209.00           300 - 4.00         NT.         146.00         0 <td>ı</td> <td>. IA</td> <td></td>	ı	. IA											
250 - 300   NT.   202.00		NO.		7							1		
250 - 300         MO.	•	.T.		202.00							209.00		
300 - 400   WT.   384.00   1	i	NO.											
300 - 400 WW. 384.00 1 400 - 500 WW. 1 446.00 500 - 750 WW. 1 703.00 1000 and Over W. 1 4941.00 1000	- 00	MT.											
NT.   384.00   1	200	ĕ	-1										
- 500   WT.   4446.00	١ ١	MŢ.	38,00										
NT.   NT.   446.00		10		7									
- 750   W.   W.	)	M.		446.00									
No   No   No   No   No   No   No   No	-	NO.		1									
and Over         WT.         1 yell 1.00         1         2         3         4	.	¥.		703.00									
MT.   MT.   1		NO.											
and Over Wr.         4941.00         Control of the con	- 1	E A	<u> </u>										
NO.   NO.	and		4941.00										
WT.         NO.         NO. <td></td> <td>M</td> <td></td>		M											
NO.         NO. <td></td> <td>.I.</td> <td></td>		.I.											
WT.   NO.		NO.											
NO.         NO.         NO.         129         182         149         168         83         51         84         41         221         83           WT.         5579.11         2031.41         767.49         617.04         417.85         507.77         649.78         314.91         1013.78         470.50		¥.											
WT.         WT.         NO.         129         182         149         168         83         51         84         41         221         83           WT.         5579.11         2031.41         767.49         617.04         417.85         507.77         649.78         314.91         1013.78         470.50		Š.											
WT.         129         182         149         168         83         51         84         41         221         83           WT.         5579.11         2031.41         767.49         617.04         417.85         507.77         649.78         314.91         1013.78         470.50		Š											
WT.         129         182         149         168         83         51         84         41         221         83           WT.         5579.11 2031.41         767.49         617.04         417.85         507.77         649.78         314.91         1013.78         470.50		<u></u>											
MO.   129   182   149   163   63   51   64   41   224   63   64   67   64   67   64   67   64   67   64   67   64   67   67		Ė		Š					ā			C	6
WT:  5579.11 2031.41  767.49 617.04 417.63 507.73 649.79 314.91 1013.70 470.50	Total	<b>.</b>	139	182	149	- 1	2	1	z c	#1	221	3	22
		W.T.	5579-11	2031-41	K#./Q/	- 1	41(.0)	ž	24.C	77.77	1013.10	4(0.72	4(2014

ONDEG Form 1490, Rev 21 Mar 60

**SECRET** 

しだ!   梅花を    、   、   、   、   、   、   、   、   、	TYPE: 279-m	279-m, XXB90	36				DATE FIRED:		12 January 1960	1960	ROUR	ROUND NO.:	2
Matchelle   Matc		positi											
Zone   Zone	S				FI	RAGMENTS	FROM WAI	REEAD					
No.   64    118   97    311   322    490   532   123   745	METGER			DISTRI	BUTTON O		NTS BY IN	UMBER AN		20			
No.   64   118   97   311   322   490   532   123   2813   123   123   123   1246   124	IN GRAIN		Zone	Zone	Zone	Zone	Zone	Zone 17	Zone	Zone	<b>H</b>		Cotel
- 1		í		0:5	5	.   [	000	. 60-	3	, [2		1	
- 2 No 3 of -	•		1	09.4%	1	74.30	28.4	1	91.60	20.80		70	596.04
- 2	l	OK M	L	17		52	33		6	5		346	
No.   12   19   35   342   34   4   4   4   323   34   4   4   4   323   34   4   4   4   323   34   4   4   4   4   323   34   34	1	Ë	L	25.02	}	73.40	04.94	F	12.56	6.89			496.60
National State   National State   13.60   11.13   13.60   13		ĦO.	Ц	19	П	7,2	31		4	-†		H	
8         MO.         9         13         10         11         10         15         132           10         WT.         56.26         80.06         67.00         69.60         61.50         91.28         91.28         91.28           10         WT.         8.20         46.12         51.26         9.94         43.05         52.60         9.4         57           15         WT.         32.26         76.40         63.00         168.00         168.00         9.6           20         WT.         33.84         33.26         35.26         19.80         2         2         2           20         WT.         44.40         21.66         20.22         19.80         2         2         2           35         WT.         11         2         2         36.00         2         36.00	•	Ę.				130.06	95.70	134	13.60	11.13			1048.87
Nat.   56.26   60.06   67.00   69.60   61.59   91.28		NO.	$oxed{oxed}$				10					132	
10         NO.         1         5         6         1         5         6         1         57           15         NT.         8.2cd         46.12         51.2cd         9.9dt         43.0d         52.6d         6           15         NT.         32.2cd         76.4d         63.0d         1         46.0d         66.0d           15         NT.         33.8dt         33.2cd         35.2d         35.2d         36.0d         36.0d           25         NT.         44.4d         21.6d         20.2d         13.3d         2         26.0d         25.0d         26.0d	•	.I.	_			! '	61.50	ĺ					833.69
- 1.0    Wr.   8.20    46.12   51.20   9.94    43.00   52.60   46.12   46.12   51.20   9.94    43.00   52.60   46.12   46.12   46.10   46.00		NO.				li	5					57	
- 15   W. 2. 22   78.40   63.00   48.00   48.00   25.0	•	M					43.00						508.29
- 17         WT.         32.26         78.46         63.06         1         48.00         936           20         WT.         33.84         33.26         35.20         19.80         22         22         22           25         WT.         444,0         21.60         20.22         43.34         22         26         26           35         WT.         27.20         38.44         26.00 </th <th></th> <td>NO.</td> <td></td> <td>1</td> <td>5</td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td>88</td> <td></td>		NO.		1	5			1				88	
20         NO.         2         2         2         1         36 <th>•</th> <td>WT.</td> <td>Ц</td> <td></td> <td>l</td> <td></td> <td></td> <td>₩.00</td> <td></td> <td></td> <td></td> <td></td> <td>807.25</td>	•	WT.	Ц		l			₩.00					807.25
25         WT.         33.84         33.26         35.26         19.80         2         22         22         22         32		MO:			۱		1					36	
- 25         NO.         2         1         1         2         2         2         2         2         2         2         3 <th>•</th> <th>MT.</th> <th>Ц</th> <th></th> <th></th> <th></th> <th>19.80</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>632.34</th>	•	MT.	Ц				19.80						632.34
- 35   WT.   444.40   21.60   20.22   43.34     25   26   26   26   26   26   26		NO.	Ц					2				8	
- 35         WT.         2         2           WT.         27.20         1         26.00         26.00           - 50         WT.         38.44         2         36.44         2           - 60         WT.         38.44         2         36.44         3         3           - 70         WT.         44.86         3         4         4         6         6           - 80         WT.         4         4         4         4         6         6           - 90         WT.         4         4         4         4         4         6           - 100         WT.         4         4         4         4         4         4           - 100         WT.         4         4         4         4         4         4		V.		25.60				43.34					1796-117
- 50         WT.         27.20         1         16 <t< th=""><th>l</th><th>MO.</th><th>L</th><th></th><th></th><th></th><th></th><th>2</th><th></th><th></th><th></th><th>8</th><th></th></t<>	l	MO.	L					2				8	
- 50         WO.         1         1         16           - 60         WT.         38.44         9           - 70         WT.         64.86         1         6           - 80         WT.         64.86         1         6           - 90         WT.         73.80         6         6           - 100         WT.         73.80         73.80         7	•	.I.M						26.00					762.09
- 50 WT. 38.44 99 - 60 WT. 1	l	MO.			1							16	
- 60 WT. 31 64.80 40.8	•	M.			38.44								658.65
- 70 WT. 64.80		MO.										6	
- 70 MT. 64.86 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		L											479.06
- 10 WT. 64.86		NO.	Ц									9	
-80 WG,		MT.	Ц										389.40
- 90 WT.		NO.						1				9	
- 90 MT. - 100 MT.		Ę.						3					43.68
- 100 MT.		<u>6</u>										2	
- 100 MT.	•	į											267.28
- TW   WII.		Q										-	
		ij											4.5

GRUBG Form 1490, Rev 21 Mar 60

SECRET

FILLER; Composition B   FRACINENTS FROM MARGEA AND WEIGHT   150	TIP: 279-1	279-m, xx390	8				DATE FIRED:	i I	12 January 1960	1960	ROUND NO.	2
National Part   National Par	FILLER: Cor	mositi	1									
WEIGHT   The Color   Line	S				FRA	MENTS F	ROM WARE	EAD				
Differential bords   12   2010   2010   2010   2010   2010   2010   170   18   19   10   10   18   19   10   18   19   19   10   18   19   19   19   18   19   19   19	METCHE			DISTRI	SUTTONO		NTS BY N	UMBER AN	WEIGHT	50		
125 - 150	DETERNALS DE CRADE		Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	Total No.	Total Weight
1 - 120	li	OH E									2	
125 - 150 MC	ı	F.										227.20
150 - 200	•	<u>.</u>										
150 - 200   WT.												
250 - 250 NO. 100 and over NO. 104 NO. 104 NO. 105 NO. 104 NO. 105 NO. 104 NO. 105 NO. 104 NO. 105 NO. 104 NO. 105 NO. 104 NO. 105 NO.	ı	E E									+	
250 - 300	l	€									2	
250 - 300         MO.         M	1	.I.	•									11.00
300 - 400   WT.	Q	MO.										
1 + 400   NT.   1 + 400   NT	- 067	WI.										
No.   No.	1	MO.									7	
1 - 500   MT.	١	¥Ţ.										38,00
NT.   NT.   NT.	ı										1	
1000   NT.   100   NT.   100	۱ ۱	$\dashv$										146.00
Mar.   Mar.	•	_								7	N	
and Over Wr. in the control with the con	١.	┪								510.00	-	1213.00
and Over         W.         1         2           W.         10.         2         38500.00         2           W.         10.         2         38500.00         2           W.         10.         2         38500.00         38500.00           M.         10.	ı											
and Over         W.         38500.00         2           W.         W.         38500.00         2           W.         W.         38500.00         2           W.         W.         380.         380.         380.           W.         100. <t< th=""><th></th><th>T.</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>0</th><th></th></t<>		T.									0	
MT.   MT.	and	1								38500,00		1941.00
WT.         WT.         Problem (Control of the Control		Q.										
WT.         WT.         NO.         NO. <th></th> <th>Ë</th> <th></th>		Ë										
WT.         MO.         MO. <th></th> <th><b>I</b></th> <th></th>		<b>I</b>										
MO.         MO.         104         182         188         417         402         617         545         134         3873           WT.         333.31         377.46         466.32         357.30         296.20         690.94         107.76         3904.82		¥F.										
WT.         104         182         188         417         402         617         545         134         3873           WT.         333-31         377-46         466-32         357-30         296-20         690-94         107-76         3904-82		<b>3</b> 0.										
MT.         104         182         188         417         402         617         545         134         3873           WT.         333.31         377.46         466.32         357.30         296.20         690.94         107.76         3904.82		£										
WT.         104         182         188         417         402         617         545         134         3873           WT.         333.31         377.46         466.32         357.30         296.20         690.94         107.76         3904.82		œ.										
W. 333.31 377.46 466.32 357.30 296.20 690.94 107.76 3904.82		5	-	,	9	1	30		1	10.5	000	
WI:   333-31   3'[1-40   400-32   35/1-30   290-20   090-94   10/1-70   3904-02	Total	ġ	707	102	82	417	405	)TO	71	134	36/3	
			333-31	3	400-32	35/630	220	₹.000	10(.01	3904.02		Track Track

ONDING Form 1490, Rev 21 Nar 60

**SECRET** 

- HAM: バゲー目, AMS S	1, XX39	0				DATE FIRED:		12 January 1960	y 1960	æ	ROUND NO.:	ณ
TITIER: Com	Composition	on B										
A			FR	FRAGMENTS FROM OUTER	FROM OUT	ER CASE	CASE (ALUMINUM)	м)				
TENT -			DISTRI	DISTRIBUTION O	OF FRACIMENTS BY		NUMBER AND WEIGHTS	ID WEIGH	ξĊ			
INTERVALS IN CEAIN		Zone	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
	<u>ğ</u>										7	₹
T - 0	W.L.	No	No	No	No	No	γo	No	No		2.37	5.54
6 - [	Ģ.									7	2	9
. ]	į	Recovery		RecoveryRecoveryRecoveryRecoveryRecove ryRecoveryRecovery	Recovery	Recovery	Recove ry	Recovery	Recovery	6.16	3.15	8,39
0	E											임
	Ė										,	35.8
ر ا ا	9										7	~
	Ę	٠									7.10	38.89
8 - 30	2											٣
١	Ş											28.25
36 - 01	Ĉ.										2	~
١	Ę										27.60	35.46
. זר כפיי	2											اد
۱ ۱	Ę.											32.40
, , , , ,	Ģ.											۲
١	Ę											24.07
1	MO.										т	٦
5) = 35	MT.										31.40	25.06
35 - 50	MO.	i										
	Ę	;										
50 - 60	Q				;							
١	ŭŢ.		• · · · · · · · · · · · · · · · · · · ·									,
Ko - 70	NO.			4.4								7
.	¥Ţ.											₹ <del>.</del> 89
20 - 02	J.											
١	Ė											3.8
80 - 60	)   											
	į.											
90 - 100	2											
-	M.T.											

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

	·//-	R				DATE FIRED:	- [	12 January 1960	y 1960	2	ROUND NO.:	2
FILER: Compc	Composition	S nc									;	
Ą			FR	AGMENTS	FROM OUT	FRAGMENTS FROM OUTER CASE	(ALUMENUM)	M)				
URI (SRT)			DISTRI	BUTTON O	F FRACINE	DISTRIBUTION OF FRACMENTS BY NUMBER AND WEIGHTS	UMBER AN	D WEIGHT	ß			
INTERVALS IN GRAIN		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
.0.	NO.											
्टा - ००७	¥.											
125 - 150	NO.											
8	NO.											
002 - 04T	WT.											
250	NO.											
253	Live											
250 - 300	01											
;	. T											
300 - 100	<u>.</u>											
100 - 200	2											
31.0	NO.											
06) - 006	WT.											
7	NO.											
$\dashv$	WT.											
Treat Cross	130											
	.I.											
1	Q											
	MT.											
1	2											
	MI.											
	NO.											
	MT.											
	10											
	¥Ţ.										-	
The	MO.	•	1	1		1	•	•	•	7	13	55
	Ė	•	-	•	-	•		•	•	6.16	71.62	350.05

OKUBG Form 1490, Rev 21 Mar 60

SECRET

148.21 139.61 108.00 150.21 85.80 159.01 319.74 68.24 73.00 236.83 169.27 102.80 Total Weight 17.7 N ROUND NO.: 493 8 7 શ 12 Q נו Total 5.79 т<u>ұ</u> **Zone** 19 January 1960 OF FRACMENTS BY NUMBER AND WEIGHTS 17.60 1.79 6.70 20.96 20.96 12.29 Zone 18 FRACMENTS FROM OUTER CASE (ALUMINUM) ដ 24.50 19.00 17.57 20.00 50.60 20.06 2.6 20.53 12.37 Zone 17 DATE FIRED: 13:29 33.00 33.28 24.52 51.66 2 16.80 37.32 37.44 Zone 16 12 39.86 13.67 28.85 28.85 16.28 Zone 15 10 32.30 DISTRIBUTION 17. Zone 14 11.57 9,83 36.20 8.52 32.28 12.94 11:25 22.51 Zone 13 80.12 8 2 80,40 27.60 230.00 33.20 52.20 38.24 3.8 49.64 17.17 **9** m Zone 12 Composition X1639 MO. MT. OF E 일 달 . E 279-目, WEIGHT INTERVALS IN CHAIN - 100 2 -35 δ જ ෂ 8 Я 75 ଷ જ **ا** ω Q 5 THERE. Tree: 0 8 H Q 5 ω Я 73 8 g 35 2 8 2 8 27

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

Total Weight

Q

TYPE:

18760.00

20638.44

ROUND NO.: Total 20 80 17 65.13 1876 F73 18760.00 January 1960 Zone 19 DISTRIBUTION OF FRACMENTS BY NUMBER AND WEIGHTS Zone 18 2 FRAGMENTS FROM OUTER CASE (ALUMINUM) 94 190.27 FRAGMENT RECOVERY Zone 17 DATE FIRED: 116 157 100.06 247.31 Zone 16 Zone 15 36 73.58 Zone 14 123.59 Zone 13 642.94 20<u>p</u> 77 あ Composition 279-ma, xxx390 1000 and Over - 1000 WEIGHT INTERVAIS IN GRAIN - 150 - 200 - 300 - 500 300 - 1400 500 - 750 200 - 250 100 - 125 FILLER:

ORDEG Form 1490, Rev 21 Mar 60

Total

**SECRET** 

8

250

28

150

न्ध

750

**SECRET** 

FRAGMENT RECOVERY

Parimer: Composition B   Fractorems for Producting Producting   Prod	TYPE: 279-mm,	m, XX3990	Q				DATE FIRED:	21	January 1960	8	ROTHED NO.:	2
National Processing   Process		positic										
National Part   Mark			Ŧ	RAGMENTS	ğ	ECTILE R	ECOVERED	FROM NOSE	AND BASE	63		
The Column   The	URT (SBT)			DISTRIB			ets by nu	MBER AND V	<b>TEICHTS</b>			
The Column   The	INTERVALS		2000	2000		Zone	Zone.		Tot		Total	Grand
0 - 1   M. 10.52   2-6   5-6   12.96   12.14   28.10   146.21   596.04   146.21   1	IN GRAIN		NA.	SN	Total	18B	19B	Total	A F		S and F	of Frags
1 - 2   WT.   10.52   9.76   20.28   12.96   15.14   28.10   148.21   596.04     1 - 2   WT.   13.60   3.03   26.63   15.38   4.45   20.31   3.46   4.45   20.31   3.46   4.45   20.31   3.23   3.46     2 - 5   WT.   22.65   13.63   14.70   14.70   22.63   10.48.87   13.20     5 - 8   WT.   22.65   12.67   19.03   14.70   14.70   22.63   10.8.87   13.20     6 - 10   WT.   17.62   8.20   25.82   10.20   13.68   14.70   14.70   22.63   10.8.20     10 - 15   WT.   11.96   10.67   22.63   12.67   10.9.27   10.8.20     15 - 20   WT.   12.67   12.67   12.63   12.67   12.67   12.60     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50   12.50     15 - 20   WT.   12.50   12.50   12.50   12.50   12.50   12.50   12.50   12.50   12.50		٩	S	8	58	Z	30	57		64	2813	3421
1 - 2         NO.         8         9         17         11         3         14         66         346           2 - 5         WT.         13.60	ı	Ę	10.52	9.76	20.28	12.96	15.14	28.10	14	22.83	596.04	792.63
2 - 5         WT.         13.60         13.65         15.86         14.45         20.31         85.80         496.60           2 - 5         NO.         1         5         12.6         13.63         14.70         14.70         23.33         13.2           5 - 8         NO.         1         2         3         18.6         14.70         14.70         22.6         133.6           10 - 15         NO.         1         2         3         1         2         133.6         133.6         133.6           10 - 15         NO.         17.62         8.20         25.82         10.65         10.65         23.80         10.65         22.34         10.65         23.80         10.65         22.34         10.65         22.34         10.65         20.34         10.65         22.34         10.65         22.34         10.65         22.34		2	8	6	17	ㅋ	3	14		62	346	439
2 - 5         NO.         7         5         12         5         14.70         14.70         29.63         10.4687         1           5 - 8         No.         22.65         15.63         14.70         14.70         29.63         10.8087         1           6 - 10         No.         1         2         1         2         2         139.61         833.69           10 - 15         No.         1         2         2         3         2         2         12.7         2         37           10 - 15         No.         1         1         2         2         2         37         3         3         3         3         3         3         3         3         3         4         3         3         4	•	Ę	13.60	13.03	26.63	15.86	4.45	20.31	3		09*96†	1629.34
5 - 8         NT.         22.65         15.03         37.68         14.70         236.83         1048.87         1           5 - 8         NO.         1         2         3         4         1         2         132           8 - 10         NO.         2         1         2         3         4         1         2         133.69         133.69           10 - 15         NT.         17.62         8.20         25.82         2         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00         506.29         10.00		MO.	7	5	ટા	5		5			323	111
5 - 8         MO.         1         2         3           6 - 10         WT.         6.34         12.67         19.01         12.62         132.63           8 - 10         WT.         17.62         8.20         25.82         106.00         508.29           10 - 15         WT.         11.6         8.20         25.82         10.34         68.20           10 - 15         WT.         11.6         10.50         10.50         10.50         10.50           15 - 20         WT.         11.6         10.50         10.50         10.50         10.50           20 - 25         WT.         11.6         11.7         11.7         22.20         12.20           25 - 35         WT.         23.60         23.80         23.90         11.7         22.20         12.20           25 - 35         WT.         NO.         11.7         12.50         14.62.09         16.20           35 - 50         WT.         NO.         11.7         12.20         9         16.20           60 - 70         WT.         NO.         11.7         12.20         11.7         12.20           80 - 90         WT.         NO.         11.7         11.7		Ę	22.65	15.03	37.68	14.70		14.70	23		1048.87	1338.08
9 - 10         WT.         6.34         12.67         19.01         139.61         833.69           8 - 10         MO.         2         1         3         1         2         1         37         6.29         1         6.29         1         6.29         1         6.29         1         6.29         1         6.29         1         6.29         1         6.29         1         6.29         1         2         2         2         2         2         2         2         2         2         2         2         2         2         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3         3 </th <th>1</th> <td><b>3</b>0.</td> <td>1</td> <td>8</td> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td>22</td> <td>132</td> <td>157</td>	1	<b>3</b> 0.	1	8	6					22	132	157
8 - 10         MO.         2         1         3         12         57           10 - 15         MO.         11.66         8.26         25.82         10.80         508.29           10 - 15         MO.         1         1         1         1         1         66.66           15 - 20         MO.         1         1         1         1         2         3.66           20 - 25         MO.         1         1         1         2         2         2           20 - 25         MO.         23.80	•	Ę	6.34	29.51	19.01				13	19.61	833.69	992.31
0 - 1/0         WT.         17,62         8,20         25,82         106,00         508,29           10 - 15         MO.         1         1         2         1         68           10 - 15         MO.         1         1         2         36         36           15 - 20         MT.         18,50         16,50         36         36         36           20 - 25         MT.         23,80         23,80         150,01         46,41         26           25 - 35         MT.         23,80         23,80         150,01         46,41         26           25 - 35         MT.         2         3,11         46,41         26         26           35 - 50         MT.         3         16,20         10,20         40,41         26           50 - 60         MT.         30         10,20         479,66         26         26           70 - 80         MT.         30         10,20         10,20         10,20         10,20           80 - 90         MT.         30         10,20         10,20         10,20         10,20           80 - 100         MT.         30         1         10,20         10,20		MO.	8	7	3					12	57	72
10 - 15         W0.         1         2         80         14         68           10 - 15         WT.         11.96         10.67         22.63         16.927         807.25           15 - 20         WT.         18.50         18.50         18.50         15.20         33.64           20 - 25         WT.         23.80         23.80         23.80         25.20         22.60         11.20         12.50         12.	•	Ę	17.62	8.20	25.82				10	38.00	508.29	642.11
P.D.         WIT.         11.96         10.67         22.63         10.92         36	۶	MO.	1	τ	2					14	88	ಹೆ
20         WO.         1         1         1         36         37         40 <th>ı</th> <td>.T.</td> <td>9°11</td> <td>19.01</td> <td>22.63</td> <td></td> <td></td> <td></td> <td>16</td> <td>59.27</td> <td>807.25</td> <td>999.15</td>	ı	.T.	9°11	19.01	22.63				16	59.27	807.25	999.15
25         WT.         18.50         18.50         18.50         18.50         18.34           85         NT.         1         1         22         22         22           85         NT.         23.80         23.80         23.80         23.80         23.80         1         26           35         NT.         NT.         23.80         23.80         23.80         26 <th>1</th> <td>NO.</td> <td></td> <td>1</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>6</td> <td>36</td> <td>9†</td>	1	NO.		1	1					6	36	9†
25         NO.         1         1         1         22           35         NT.         23.80         23.80         23.80         25.80         26.41		WI.		18.50	18.50				15	20.21	632.34	801.05
47         WT.         23.80         23.80         23.80         11         26           35         WT.         11         26         11         26           50         WT.         11         26         11         26         12         26         12         26         12         26		<b>3</b> 0.		τ	1					7	ผ	30
35         WO.         11         26         11         26         11         26         11         26         12         12         26         12         16	1	H.		23.80	23.80				15	10.6	14.964	679.22
30         WT.         319.74         762.09         1           50         WT.         3         16         1           60         WT.         102.80         479.06         1           70         WT.         102.80         479.06         1           80         WT.         100.80         100.40         100.80           90         WT.         100.80         100.80         100.80           100         WT.         100.80         100.80         100.80		10								11	%	37
50         WT.         3         16           60         WT.         2         9           70         WT.         102.80         479.06           80         WT.         102.80         479.06           90         WT.         1         68.24         389.40           100         WT.         1         6           100         WT.         1         6           100         WT.         1         6           WT.         1         1         6           WT.         1         1         6           100         WT.         1         1         6           WT.         91.80         91.80         91.20         94.12	ı	M.							33	19.74	762.09	1081.83
50         WT.         117.72         658.65           60         100.         100.00         479.06           70         WT.         100.00         100.00         100.00           80         WT.         100.00         100.00         100.00           100         WT.         100.00         100.00         100.00           WT.         91.80         91.80         91.12		MO.								m	16	33
60         NO.	• ]	Į.							7		658.65	776-37
Mar.   Mar.   102.80 479.06		MO.							-		6	11
70         NO.         NO.         1         6           80         NO.         NO.         1         6           90         NO.         1         1         2           100         NO.         1         1         1	•	L							77		479.06	581.86
William   68.24   389.40		<b>M</b> 0.									9	7
80         #7.         1         6           90         #7.         1         1         2           100         #7.         1         1         1         1           100         #7.         91.80         91.80         94.12	:	L							7	78°57	389.40	457.64
90         WT.         73.00         434.66           90         WT.         1         2		NO.								7	9	
90         NO.         167.20           100         NT.         91.80         91.80	•	Ĭ.								3.8	434.66	507.66
NO         WT.         167.20           100         WT.         91.80         91.80         94.12		MO.									2	2
100 WT. 91.80 91.80 1.80 1.80 1.80		Į.									167.20	167.20
+w   WT.   91.80   91.80   94.12		10	1		1						1	2
		Ę	91.80		91.89						<u>ج</u> انع 12	185.88

ONDEG Form 1490, Rev 21 May 60

SECRET

23.00 384.00 446.00 227.20 00°TC1 20°1028 4756 75524.57 Grand Total Frags Q ROUND NO.: Total S and F 227.20 411.00 384.00 1213.00 18760.00 43441.00 709 3873 20638.44.54526.87 Frags DATE FIRED: 12 January 1960 Total Frags FRACIMENTS OF PROJECTITE RECOVERED FROM NOSE AND BASE DISTRIBUTION OF FRACMENTS BY NUMBER AND WETCHTS 63.11 Total 19.59 **Zone** 193 43.52 200 183 183 Total 111.66 286.15 Son Son 174.49 2005 EF Composition TTE: 279-m, X0390 .000 and over 750 - 1000 VELCHE INFERVALS IN CRAIN - 750 स्थ-- 150 - 200 - 25 - 30 84 -1 8,2 FILTER: Total 8 25 8 8 8 125 8 8

FRAGMENT RECOVERY

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

Table IV (S). FRAGMENT RECOVERY

TTE: 279-	279-m, xx390	06				DATE FIRED:	RED: 25	January 1960	1960	22	ROUND NO.:	3
THATER: CO	Composition	00 E										
					FRAGMENTS	S FROM WARTERAD	ARREAD					
TARLICARI			DISTRI	DISTRIBUTION C	OF FRACMENTS BY		NUMBER AN	AND WEIGHTS	<b>55</b>		,	
IN GRAIN		Zobe 1	Zone	Zone 3	Zone	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone . 10	2006 11
	MO.	111	173	11.	93	62	45	33	32	45	92	104
0 - 1	WT.	29.50	53.25	32.29	31.40	22,48	16.75	12.50	7.22	16.90	7.44	25.86
	щ.	20	<b>7</b> 2	52	23	8	5	5	7	17	8	19
Z - T	W.	. 58°12	33,85	25.47	31.28	84.11	6.39	6.90	9.80	20.30	60°टा	19.10
	MO.	25	ದ	<del>1</del> 2	31	11	п	10	15	72	п	17
2 - 5	WT.	76.04	£8°03	80.20	97.20	36.80	38.80	29.28	45.80	37.30	10.50	53.20
	NO.	4	8	<b>₹</b> ፒ	9	13	1	9	9	10	9	9
2 - 6	Į.	27:39	52.36	93.44	42.80	83.60	5.80	39.00	42.60	64.80	35.46	43.08
	<b>1</b> 0.		5	5	2			7		9	3	5
or - 2	W.		19.00	12.44	18.80	69.6		00. <del>†</del> 9		55.72	29.10	46.22
	NO.	τ	5	9 .	9		9	17	8	5	2	3
CT - OT	MT.	하.하	29°85	77.42	71.80	138.54	69.80	19.20	₩.66	62.06	29.15	36.80
	<b>€</b>		3	. 9	2	9		3	2	5	5	#
02 - CT	¥.		54.65	101.05	33.60	102.52		51.00	35.00	89.60	93.40	77.80
	NO.	1		2	2	3 .	2	17	17	1	1	4
20 - 25	ĬŢ.	23.57		04.54	45.60	09*+9	45.60	92.62	87.48	23.00	22.85	91.B
	M	,	τ	2	1	3	1	9	1	1	3	4
25 - 35	H.		15.05	24.80	25.52	80.20	28.60	172.00	28.50	35.00	97.20	21.121
	MO:		τ	3		1	2			1	3	2
35 - 20	M.		00°0 <del>1</del> ।	120.00		00°0†	84.86			09.54	127.40	81.60
	MO:			7					2	1		1
8 - %	MT.			108.32					103.00	58.60		51.00
	<b>1</b> 0		2							. 1	1	
2 - 8	W.		131.20							61.60	63.84	
	<b>1</b>	ı	1									
8 - 2	W.	73.90	72.60									
	10											
8 - 8	į											
	ရ	1	1									1
MT - 76	MT.	92.52	96.60									91.66

ONDEG FORM 1490, Rev 21 Mar 60

SECRET

FRAGMENT RECOVERY

	mype. 279-1	279-118m X1/300	8							3,25	1		1
<u>'</u>							THE PERSON		2) Jamary 1900	2	1	ROURD BO.	4
	FILTER: Composition B	positio	B B										
					E i	RAGMENTS	FRAGMENTS FROM WARREAD	RHEAD					
	WEIGHT			DISTRI	DISTRIBUTION C	F FRACIME	OF FRACMENTS BY NUMBER AND WEIGHTS	UMBER A	O WEIGHT	S			
	INTERVALS IN CHAIN		Zone	<b>Zone</b> 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	6 euoz	Zone 10	Zone
<u> </u>	100 - 125	M	τ									7	
	/	M.	∞.111									116.60	
_	125 - 150	MO.	1		1								
		5	143.00		131.00								
	150 - 200	Ĭ0.	٦	1	τ							ī	
		Ę	150.00	152.00	174.00							274.00	
	200 - 250	NO.			•								
Ц		WI.	•										
	250 = 300	NO.	τ										
 32	ı	W.	255.00										
	300 - 400	NO.											
	- [	Š											
···	100 - 500	٠ چ		1									
_1		į.		413.00									
	500 - 750	2											
	- [	į											
	750 - 1000												
T		1	•			7							
<u> </u>	1000 and Over	5	T 0366										
L		_	22.50						1				
		5											
L		0											
		5											
L.		<b>1</b> 00											
		W.											
L.,		.01											
		W.											
	Betes	MO.	169	242	208	390	911	73	92	E	Ħ		170
_]	TOOL	5	1784.01	1259.78	99.8801	395.00	589.91	296.60	516.50	458.84	570.48	<b>E</b>	733.52

OROBG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

THILER: Composition B   THILE: Composition B		y XMB5	Q				DATE F	l	January	1960	<b>DE</b>	CUITO NO.:	1
National N	i	positi	g										
Mathematical Mat					FR	AGMENTS	FROM WAR	HEAD					
Titachalls   Score   Zone   Zone   Zone   Zone   Zone   Zone   Ne.   N	VICTORE			DISTRI	SULTON C	F FRACTAE	MES BY M	IMBER AN	D MEIGHT	ស្ព			
0 - 1         NO.         53         103         326         369         987         511         67         3594           1 - 2         WT.         13.50         27.06         99.84         100.16         84.38         185.46         68.60         12.36         14.14           2 - 5         WT.         17.30         34.28         63.42         13.28         55.60         27.21         4.11         403           2 - 5         WT.         46.40         62.80         39.44         13.75         13.28         55.60         27.21         4.11         403         13.9           5 - 8         WT.         46.40         62.80         39.44         13.75         13.28         55.60         27.21         4.13         403         13.9         4.14         403         13.9         40.32         55.77         32.76         52.80         13.6         13.9	INTERVALS IN GRAIN		Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18			Total No.	Total Weight
1 - 2   NT.   13.50   27.06   99.84   100.16   84.38   135.46   68.60   12.36   4114   4114   4134   41.20		Щ М	53	103	328	326	369	987	511	29		3594	
1 - 2   NC   1.13   3.23   1.14   1.15   1	·	į.	13.50	27.08	₩.66	100.16	84.38	185.46	99.89	12.36			846.97
2 - 5         MO.         11.30         39.42         39.42         39.42         39.42         39.42         39.42         39.42         39.42         40.31         10. <th>ı</th> <th>0</th> <th>13</th> <th>23</th> <th>## ##</th> <th>2 2 2 2 3 2 3</th> <th>37</th> <th>59</th> <th>8</th> <th>.<del></del></th> <th></th> <th>414</th> <th>-00</th>	ı	0	13	23	## ##	2 2 2 2 3 2 3	37	59	8	. <del></del>		414	-00
2 - 5         WT.         46,40         62,80         98,94         117.52         103,80         13.65         139         139           5 - 8         NO.         9         6         15         9         5         13         2         139         139           8 - 10         NO.         9         6         15         9         5         13         2         139         139           10 - 15         NO.         17.60         9.37         36.76         59.78         37.18         9.58         15         9.58           10 - 15         NO.         17.60         9.37         36.76         59.78         47.14         16         50           15 - 20         NO.         1         1         1         1         3         3         45         145           15 - 20         NO.         1         1         1         1         1         3         3         45         145         14         45         14         45         14         45         14         45         14         45         14         45         14         45         14         45         14         45         14         45			130	34.60	220	20.05	25.50	00.60	120/2	77.77		703	200.02
5 - 8         NO.         9 - 6         15 - 9         5 - 13         2         139         139           8 - 10         NO.         NO.         1.52         3.00         94.92         55.74         32.78         8.86         11.69         20           8 - 10         NO.         NO.         4         5         1.0	ı		46.40	62.80	8,8	75	103.80	195.80	31.65				1250.06
National N	1	MO	6	9	15	6	5	13	2			139	
8 - 10         M0.         2         1         4         7         4         1         50           10 - 15         M7.         17.80         9.37         3.4.06         38.82         47.14         85.72         85.72         63.20         118.31         24.06         38.82         47.14         85.72         85.72         63.20         118.31         24.06         38.82         47.14         45.7         11         11         3.4         3.4         85.20         12.04         3.4	• [	Ę	63.22	39.00	94.92	55.74	32.78	82.86	11.69				910.5年
MT.   17.80   9.37   36.76   59.78   37.18   9.58   B5   M5   M7   M7   M7   M7   M7   M7   M	ı	္ဌ	2	7	7	7			٦			20	
10 - 15         MO.         4         5         10 - 10         3 - 3 - 3 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -		Ė	17.80	9.37	36.76	59.78		37.18	9.58			-	457.27
NT.         56.72         63.20         118.31         24.06         38.82         47.14         45.46         45.40	- 01	2	7	5	2	2	7	4				85	
20         NO.         4         1         1         1         3         45         45           25         NO.         3         23.26         20.16         24.80         26.80         26.80           35         NO.         3         3         3         2         2         31         2         26         31         31         31         36         31         32 <td< th=""><th>- ]</th><th>Ē</th><td>56.72</td><td>63.20</td><td>118.31</td><td>24.98</td><td>38.82</td><td>47.74</td><td></td><td></td><td></td><td></td><td>1050.07</td></td<>	- ]	Ē	56.72	63.20	118.31	24.98	38.82	47.74					1050.07
- 25	ı	9	7		ر ا	7		7				45	3
- 25 MV: 21.26 23.26 20.16 24.80 21.30 31 31 31 31 31 31 31 31 31 31 31 31 31	۱	1	30.00	ļ	13.74	10.40		22.22				90	20.17
- 35 MO. 34 102.00 57.26 31 31	ı	2 5	7 5	70 60	71 00			100				R	20 463
- 50 MT. 80.34 102.00		9	25.13	3	27.73			30				31	
- 50 NT. 36.26	ı	Ę	88.34	102.00				57.96					910.11
- 60 MG. 1 - 70 MG. 2 - 80 MG. 68.84	ı	MO.		-1								14	
- 60 MG. 1 - 70 MG. 1 - 80 MG. 68.84	١	WI.		36.26									575.72
- 70 MT. 56.00 - 80 MT. 68.84 - 80 MT 90 MT 3	1	Qi		7								7	
- 70 MO. 3 - 80 MO. 68.84 22 - 90 MO. 90. 90. 90. 90. 90. 90. 90. 90. 90. 90		Ė		56.00									376-92
- 80 MG 85.84 - 90 MG 100 MG 3	ı	<u></u>		-								5	ľ
- 80 MT. - 90 MT. - 100 MT.		5		æ. 88									325.48
- 90 MT. - 100 MT.	ı	<b>2</b>										2	1
- 90 NT. - 100 NO.	- 1	Ę.											146.50
- 100 MO.	1	E											
- 100 NO.	١	Š											
	1	E										3	
		M.T.											200

ORDEG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

TATE: 270-11	279-mm x2x390	8				DATE FIRED:		25 Jameury 1960	1960	DOM	ROUND NO.	٠,
	Composition	on B										
				FRAC	MENTS F	FRACWENTS FROM WAREEAD	EAD				,	
THE LOSE!			DISTRI	BUTTON O	F FRACME	DISTRIBUTION OF FRACMENTS BY NUMBER AND WEIGHTS	UMBER AN	D WEIGHT	22			
INTERVALS IN GRAIN		Zone 12	Zope 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	6	Total No.	Total Weight
11	<u>6</u>										2	
100 - 125	WT.											227.60
051 - 861	0≟										2	37
										1	1	3.5
150 - 200											•	650.00
	NO.											
200 - 250	MT.											
i	NO.										1	
250 - 300	WE.											255.00
300 - 1700	<u>و</u>											
1	Ē										•	
100 - 500	2 5		ŀ							Ť	1	13.00
	10									T		2
500 - 750	Š											
. 750 - 1000												
Total Para COOL									2		m	X
									חטיכובט	$\dagger$		3
	<u> </u>						1			1		
	<b>1</b> 0.											
	<b>3</b> 0.											
	MT.											
	Q											
	5	_				,			Č		- CC0-1	
Total	2	387.14	166 522.01	551.79	456.74	313.06	769.00	148.73 40531.47	10531.77	+	4033	52222
		4										

ONDIG FOUR 1490, Rev 21 Mar 60

FRAGMENT RECOVERY

TYPE: 279-mm, XM390	y XMB9	0				DATE FIRED:		25 January 1960	1960	RO	ROTHED NO.:	3
FILTER: Comp	Composition	n B				,						
	:		H	FRAGMENT'S FROM OUTER	FROM OU	TER CASE	CASE (ALUMINUM)	UM)				
WETCHE			DISTRI	BUTTON C	F FRACME	DISTRIBUTION OF FRACMENTS BY NUMBER AND WEIGHTS	UMBER AN	ID WEIGH	ξ <b>3</b>			
INTERNALS IN GRAIN		Zone 1	Zone	Zone 3	Zone lt	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
	ij.	§.	ON.	No	No	ON	No	No	ON		8	45
T - 0	M.										3.47	14.35
	MO.	R	R	ጸ	R	R	R	R	R	1	17	
Z - T	WI.	Э	ə	9	ə	Э	9	е	ə	1.89	6.80	4.37
	NO.	ວ	ပ	၁	ပ	ပ	ပ	ပ	ပ	1	2	
2-5	WI.	0	0	0	0	0	0	0	0	3.55	7.32	18.53
	NO.	Α .	Λ	Α	٧	Λ	V	V	Λ			9
٥- ٥	MT.	Ģ	a	ə	е	Э	ə	9	ə			38.46
٥	MO.	H	ı	4	r	ı	1	r	ı			7
OT - 0	WI.	y	λ	Å	У	K	У	У	У			9.60
-	MO.						•				2	2
CT - OT	WT.										22.85	24.70
	M									ı	2	٦
72 - CT	WT.									18.74	32.84	16.00
	MO.											1
20 - 25	WI.											21.06
	<b>3</b> 0.											ď
22 - 32	WT.											52.0t
	MO.											2
32 - 20	WT.											79°±8
	MO.											٦
8 - 2	W.											51.06
	NO.											
02 00	MT.											
6	MO.											
0 - 0/	W.											
	MO.											
8 - 8	W.											
	<b>3</b> 0.	ı	-	•	•	t	•	•	•			
00T - 06	W.	•	•	•		•		1	1			

ONDEG Form 1490, Rev 21 Mar 60

70 334-79 Zone ROUND NO.: 73.28 Zone 10 24.18 Zone 9 January 1960 Zone 8 ı 1 DISTRIBUTION OF FRACKENTS BY NUMBER AND WEIGHTS Zone 7 1 • FRAGMENTS FROM OUTER CASE (ALUMINUM) 25 Zone 6 DATE FIRED: , ı Zone 5 . ŧ Zone 4 • Zone 3 • • Zone 2 1 1 Zone Composition 279-m, xx3990 .000 and over 750 - 1000 WEIGHT INTERVALS IN GRAIN 88 - 50 125 - 150 8 100 - 125 200 - 250 300 - 100 500 - 750 TILLER: Total TYPE: 150 250 8

FRAGMENT RECOVERY

ORUBG Form 1490, Rev 21 Mar 60

**SECRET** 

FRAGMENT RECOVERY

TTPE: 279	279-mm, XM390	38				DATE FIRED:		25 January 1960	y 1960	*	ROTHED NO.:	۳
FILLER: C	Composition	lon B										
			E	FRAGMENTS FROM OUTER	FROM OU	JUER CASE	(ALUMINUM)	ком)				
VISICEEL			DISTRI	DISTRIBUTION O	OF FRACMENTS	ΒY	UMBER A	NUMBER AND WEIGHTS	8			
INTERVALS IN GRAIN		Zone	Zone 13	Zone	Zone 15	Zone	Zone 17	Zone	Zone		Total	Total
ć	, E	50	₹	12	8	119	193	↓	3		599	
1	¥.	19.09	8.75	7.06	25.56	36.36	48.65		0.37			179.83
1 - 2	<b>™</b>	9	13	7,4	6	75	8				23	
	Ę	8°14	19.34	19.92	2.0	9 <del>1</del> *91	<b>%⁺π</b>	Ц				105.16
2 - 5	9	2,00	F C	13	7	8	5	2			7	
	i	32.40	35.05	42.70	45.64	20.50	15.95					223.97
5 - 8	2	2	7	2		#	3				118	
1		20.21	5.79	12.24	7	æ. ₹.	20.95					#. <del>1</del> 1
8 - 10	E	3	אם מינ		20.		2				ខ	
1	Ç	200	30.01	- 	† ° °	-	80.7				•	8.18
10 - 15	Ę	27.57		15.01	32.10	ָבָּרָ בַּי					7	10 Oct
	9										٥	20007
S - CT	Ĭ.	17.40				19.59						104.57
8	¥0.	τ				2					4	
	5	3.8				01.44						₹†**68
25 - 35	2	200									7	
1		755.00										ਰ ਨੂੰ
35 - 50		135 30				2 2					7	23.0
						7					ç	7.7
5 - 8						57.74					1	308 BO
60 - 70	MO.	1									-	
1	Į.	63.60										61.60
70 - 80	ġ					1					7	
H	E					77.52			·			77.52
8	⊇											
-	Į.											
8 - 100	2											
	MT.											

ONDEG Form 1490, Rev 21 Nar 60

SECRET

FRAGMENT RECOVERY

Con B   FRACMENTS FROM OUTER CASE (ALUN   DISTRIBUTION OF FRACMENTS BY NUMBER   12   13   14   15   16   17   17   18   17   18   18   19   19   19   19   19   19	TYPE: 279-mm, XX890	, xx89	0				DATE FIRED:		25 January 1960	1960	ROUND	ROUND NO.:	3
NET CREEK   ALCOHOL   AL	FILLER: Co	mposit	밍										
National Parameter   12   13   14   15   16   17   18   19   19   19   19   19   19   19				Œ	RAGMENTS	FROM OU	TER CASE	(ALUMEN	UM)				
	LIET (287)			DISTRI	BUTTON O	F FRACME	INTE BY N	UMBER AN	<b>D WEIGH</b>	23			
100 - 125	INTERVALS IN CEALU		Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	# "		lotal Jeight
125 - 150	אַנר - אַנ	<u>ğ</u>											
125 - 150 MC MT MT MT MT MT MT MT MT MT MT MT MT MT	( <del>)</del> - MT	H.										Ī	
150 - 200   NT.   NT.	۱ ا	일											
150 - 200 MO.	ı	WT.											
250 - 250	ı	MO.											
250 - 250         MO.         M		WI.											
250 - 300 MT.	1	NO.											
250 - 300 MC.	1	WI.				,							
300 - 400 MD.  300 - 400 MD.  400 - 500 MT.  500 - 750 MT.  1000 and over MT.  1000 and o	250	MO.											
0 - 400	2	Į.											
No.   No.	300 - 100	NO.											
1 - 500   MC   MC   MC   MC   MC   MC   MC	Jun - 200	WT.											
MT.   MT.   MT.	ı	MO.											
1.000   MO.   MO.	١.	Ĭ.											
MT.   MT.   MT.		<b>H</b> 0.											
1000   NO.		W.L.											
wit.         Wit.         1 </td <th></th> <th>MO.</th> <td></td>		MO.											
and Over         MO.         MO		M.											
MT.   MT.	and									٦	•	7	
MT.   MT.										18620,00		-	Bearoo
WT.   WT.		MO.											
MO.   MO.		W.											
WT.   FO		NO.											
MT.   St. 516.60   88.50   93.99   130.84   401.14   115.17   25.05   13820.37		¥.											
WT.         FO		NO.											
MT.   516.60   88.50   93.99   130.84   401.14   115.17   25.05   13820.37		WT.											
WT.   84   51   57   108   151   211   120   4   877   877   1401.14   115.17   25.05   11820.37		MO.											
NO. 84 51 57 108 151 211 120 4 877   877     WI. 516.60 88.50 93.99   130.84 401.14 115.17   25.05   1880.37		WT.											
Wr.   516,60   88,50   93,99   130,84   401,14   115,17   25,05   1880,37		MO.	ಹೆ	51	57	108	151	נונ	120	†r	3		
	TEACH.	W.	216.60	88.50	93.99	130.84	<b>†1° τ0</b> †	115.17	25.05	1850.37		Q	0423.91

ONDEG Form 1490, Rev 21 Mar 60

FRAGMENT RECOVERY

TYPE: 279-m	279-m, xx390	360				DATE FIRED:	1	25 January 1950	ြိ	ROTATO NO.	3.5
::	Composition	tion B					1				.
			E	FRAGMENTS	RECOVERED		FROM NOSE AND BASE	BASE			
WEI (SPP.			DISTRI	DISTRIBUTION O	OF FRACMENTS	BY	NUMBER AND WEIGHTS	WEIGHTS			
INTERNALS								Total	7	Total	Grand
III GRAIM		NT.	SN SN	Total	18B	Zone 19B	Total	Alumir Fregs	minum gs ]	Aluminum Warhead Frags Frags	4
	ě Š	32	30	69	ω	12	8		١.,	3504	1454
١	Ē.	38.11	10,75	22.61	2,88	5.36	8.24	17	179.83	846.97	1057.65
0	ĬO.	٥٦	7	17	3	1	4		73	414	508
	Ë	13.51	10,33	23.84	74.42	1.35	5.77	10	105.16	580.65	715.42
2 - 5	9	2	ω	87	m		3		7.7	γ <sub>0</sub> 3	495
	Ë	33.66	24.67	58.33	10.65		10.65	22	223.97	1250.06	1543.01
5 - 8	E	9	2	8					18	139	165
ı	Ę	38.62	12,15	50.77				111	114.34	910.54	1075.65
3	Q	2	Q	7	7		1		10	50	65
,	Ė	16.58	18.96	35.54	8,45		8.45	[6]	91.90	457.27	593,16
10 - 15	ě	5	•	2					11	85	101
	Š	65.60		65.60				130	130.24	1050.07	1245.91
15 - 20	ğ	ı	7	7					9	45	53
	į	18.84	18.64	37.48				100	104.57	791.62	933.67
8	Q	7	2	3					7	58	35
١	Ę	20.16	45.00	65.16			_	<b>Θ</b>	14. 68	20.929	780.62
25 - 35	G								7.	31	38
	5							702	204.04	11.016	1114.15
35 = 50	E	2		2					7	17.1	23
	E	8.8		8.8				315	312.50	575.72	23.986
20 -	ġ.	7	ı	5					ય	7	п _
	Ę	56.60	54.48	12.08				100	108.80	376.92	597.80
02 - 09	1								1	5	9
	į							6	61.60	325.48	387.08
70 - 80	Š.								1	2	3
- 1	Ē							7.	77.52	146.50	20,422
80	Q										
-	.I.M										
90 - 100	M									3	3
1	Ĭ.									280.74	280.74
2.10	1	;									:-

ORDBG Form 1490, Rev 21 Mar 60

SECRET

	TYPE: 279-mm,	m, XI39	3				DATE FIRED:		25 January 1960	y 1960	ROUND NO.	NO.: 3
NEIGHT   PROGREMEND FROM HOGER AND DAKE		positi	ផ្ត									
WEIGHT   Tree			H	AGMENTS	RECOVERE	D FROM I	OSE ALD	BASE				
Incomplete   Inc	1.00 T (1.00 t)			DISTR.		F FRACT		NOTIBER AN	D WEIGHT	ស		
125 - 150         WT.         ROL	INTERNALS IN GRAIN		Zone	Zone 2N	Total	Zone 18B	Zone 19B	Total		Total Aluminum Frags		Grand Total All Fregs
100 - 125   WT.		MO.									ત	
125 - 150   NO.    1	WI.									227.60	227.	
150 - 200   NT.   NT.	1	MO:									2	Ī
150 - 200   NO.   100	١	M.									274.00	274.
200 - 250 NO. NO. NO. NO. NO. NO. NO. NO. NO. NO.	1	NO.									4 037	KED
250 - 350		NO									20.00	
250 - 300	•	Ę										
250 - 300 Wr. No. No. No. No. No. No. No. No. No. No		10									1	
300 - 400 WT.	- 250	WT.									255.00	255
No.   NT.   NT.	_	NO.										
1 - 500   NO.   NO.		M.										
No.   NT.   NT.   NT.		E									1	
1 - 750   NO.	۱	Ę									413.00	413
MT.   MT.   MT.		NO.										
1000   WT.	•	Ę										
writ.         W I.         I I I I I I I I I I I I I I I I I I I	ı	2										
and Over         WT.         18620.00 http://u.oo           NO.	ł	J. C.								-	~	
NO.         NO. <th>and</th> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>18620,00</td> <td>44274.00</td> <td>62894.0</td>	and	1								18620,00	44274.00	62894.0
WT.         NO.         NO. <th></th> <td>NO.</td> <td></td>		NO.										
NO.         NO. <th></th> <td>Ĭ.</td> <td></td>		Ĭ.										
WT.         NO.         NO.         TO         53         123         15         13         28         877         4633           WT.         373.43         195.98         569.41         26.40         6.71         33.11         26423.91         5522227		NO.										
NO.         NO.         TO         53         123         15         13         28         877         4633           WT.         373-43         195-98         569-41         26.40         6.71         33-11         20423-91         5522227		MT.										
NT.         NO.         TO         53         123         15         13         28         877         4633           WT.         373-43         195-98         569-41         26.40         6.71         33-11         20423-91         5522227		NO.										
NO.         TO         53         123         15         13         28         877         4633           WT.         373-43         195-98         569-41         26.40         6.71         33-11         2023-91         5522227		WT.		i								
WT.         70         53         123         15         13         28         877         4633           WT.         373-43         195.98         569.41         26.40         6.71         33.11         2023.91         5522227		NO.										
NO.         70         53         123         15         13         25         37.1         453.3           WT.         373.43         195.98         569.41         26.40         6.71         33.11         20.23.91         55222.27		Ę						,			-	100
WT.   373,43   195,98   569,41   26,40   6,71   33,11		<b>₽</b>	2	23	123	15	13	88		222	4833	5861
	TenoT.	Ę	373,43	195.98	569.41	26.40	6.77	33.11		2023.91	55222	76240.7

FRAGMENT RECOVERY

ORDBG Form 1490, Rev 21 Mar 60

#### 3.3 Analysis of Data

(U) The initial velocity (Vo) of the fragments was obtained by using the following equation:

$$V_0 = V_p \quad e^{\frac{8r}{1/3}} \quad -1 \quad \text{where}$$

$$\frac{8r}{m_0 \cdot 1/3}$$

 $V_p$  = photographic velocity, fps.

r = distance from projectile to target, feet.

 $m_r$  = the representative fragment weight, grains.

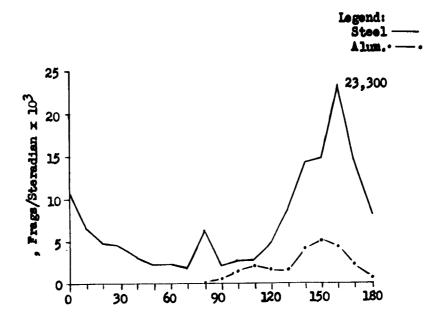
- a = 12 KdpK -2/3; where K is the fragment shape factor, p is the air density in grains/inch3, and Kd is the representative fracment drag coefficient.
- (U) For a more complete and detailed definition see Appendix B.
- (U) Since no separation of the photographic velocities was possible for the two types of metal, the initial velocities were computed using the drag characteristics for steel fragments. These initial velocities were then considered applicable to both the steel and aluminum fragments.
- (U) The initial fragment velocities, and the density of fragments per steradian for each 10-degree increment, are shown in Table V. See Figure 8 for a graph of density and initial velocity.

Table V (S). Average Fragment Velocity and Density, Rounds 1, 2, and 3

•	Da seus a	Initial Velocity,	per S	Fragments teradian
Zone	Degree	fps	Steel	Aluminum
1	0	3300	10287	<b>a</b> .
2 3 4	10 20	3700 4550	6324 4525	a
3		4550	4525	8.
4	<b>3</b> 0	4900	4414	a
5	40	5050	3032	8.
5 6 7	50 60	5050	2145	a.
7	60	5050 5300	2239	a
8	70	5450	1785 6272	a
.9	80	53 <b>5</b> 0	6272	192
8 9 10	90	4900	2095	599
11	100	5000	2672	1479
12	110	4650	2735	2046
13	120	57.50	4713	1648
14	130	6350	8963	1642
15	140	6200	14206	4102
16	150	5600	14638	5077
17	160	4700	23360	4414
18	170			
		3950	14363	2238
19	180	3500	8491	69 <b>8</b>

<sup>a</sup>No aluminum fragments recovered in Zones 1 to 9.

AVERAGE FRACMENT DENSITY, , vs ANGLE 0



AVERAGE INITIAL VELOCITY, Vo, vs ANGLE 9

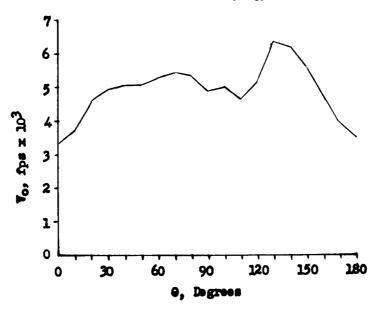


Figure 8

(U) Table VI presents the number and weight of fragments recovered.

Table VI (S). Actual Fragment Recovery

	8	teel Fra	zments	Alum	inum Fra	gments
Round.	Total <sup>a</sup> Weight, gr	Total <sup>8</sup>	Average <sup>b</sup> Weight, gr	Total <sup>a</sup> Weight,	Total <sup>a</sup> No.	Average <sup>C</sup> Weight,
1 2 3	54,623.25 54,876.13 55,824.79	5366 4047 4984	2.07 2.83 2.32	21,224.33 20,638.44 20,423.91	810 709 877	2.87 2.65 2.06

<sup>\*</sup>Including fragment recovery from the extra mose and base boxes placed at 35 feet.

(U) Table VII presents the integrated fragment data.

Table VII (S). Integrated Recovery Data

		All Frag	gments		Excludin	g Large	Fragments
Rd No•	As Fired Wt, 1b	Inte- grated Wt, 1b	No. of Frags	Per Cent Recovery	Integrated Wt, 1b	No. of Frags	Avg Frag Wt, gr
			Steel	Fragments	•		
1 2 3	34•95 34•90 34•68	28.28 27.16 28.68	59,860 47,937 59,410	80.9 77.8 82.7	22.05 20.95 22.36	59,858 47,935 59,407	2.58 3.06 2.63
			Alumir	num Fragments			
1 + 2 3	10.73 10.73 10.73	8.93 7.64 7.44	11,164 10,476 12,099	83.2 71.2 69.4	6.23 4.96 4.78	11,163 10,475 12,098	3.90 3.32 2.77

The average steel fragment weights were determined by excluding large fuze and antenna pieces which did not break up. From all three rounds one large fuze fragment weighing approximately 4500 grains was recovered. From rounds 1 and 2, one large piece of the antenna weighing 38,500 grains was recovered, and from round 3 two large pieces with a combined weight of 40,515 grains were recovered.

The average aluminum fragment weights were determined by excluding one large fragment, weighing approximately 18,750 grains, from all rounds. This fragment was from the rear part of the projectile body.

(U) Table VIII presents the integrated data scaled to 100 per cent recovery.

Table VIII (S). Integrated Data Scaled to 100 Per Cent Recovery

Round No.	Scaled No. of Fragments	Weight Scaled Excluding Large Fragments, 1b Steel Fragments	Average Fragment Weight Excluding Large Fragments, gr
1 2 3	73,986 61,598 71,826	27•25 26•92 27•04	2.58 3.06 2.63
Average	69,137	27.07	2.74
		Aluminum Fragments	
1 2 3	13,419 14,708 17,447	7.48 6.97 6.90	3.90 3.32 2.77
Average	15,191	7.12	3.28

(U) The total number of fragments produced was determined by the following equation:

$$N = 2 \pi \int_{-\infty}^{\infty} \sigma (0) \sin \theta d\theta$$

where  $\mathcal{O}(0)$  = Scaled number of fragments per unit solid angle (Steradian).  $\mathcal{O}$  = Angle from axis of shell as measured from the nose. See Table V for fragment density per steradian.

(U) Table IX presents the per cent of weight and number of the scaled fragments (100 per cent) for each weight interval based on the averages of all three rounds.

Table IX (S). Per Cent of Weight and Number of the Scaled Fragments for Each Weight Interval

	Steel Fragments			Aluminum Fragments		
Weight Interval,	Per Cent of Weight	Per Cent of Number	Average Weight, gr	Per Cent of Weight	Per Cent of Number	Average Weight, gr
0 - 1 1 - 2 2 - 5	4.84 3.85 8.51	69.56 9.48 9.42	0.25 1.43 3.18	4.13 2.85 6.89	66.10 9.98 10.31	0.31 1.42 3.30

44

	St	el Fragme	nts	Aluminum Fragments		
Weight Interval,	Per Cent of Weight	Per Cent of Number		Per Cent of Weight	Per Cent of Number	
5 - 8 8 - 10 10 - 15 15 - 20 20 - 25 25 - 35 35 - 50 50 - 60 60 - 70 70 - 80 80 - 90 90 - 100 100 - 125 125 - 150 150 - 200 200 - 250 250 - 300 300 - 400	6.79 3.74 7.50 5.88 4.97 7.19 5.75 3.43 3.53 2.22 1.00 1.83 1.37 0.95 2.18 0.04 0.07	3.75 1.48 2.18 1.21 0.78 0.87 0.49 0.23 0.19 0.01 0.04 0.07 0.02 0.02 0.02	6.38 8.94 12.12 17.22 22.36 29.29 41.10 53.55 64.55 73.92 84.41 92.36 110.84 136.35 167.22 208.25 255.00 384.00	4.67 3.57 5.02 4.08 5.14 10.00 10.14 2.50 2.62 2.55 2.15	3.66 1.95 2.06 1.19 1.12 1.71 1.19 0.24 0.20 0.17	6.31 9.02 12.06 16.93 22.68 28.88 42.00 52.58 65.75 75.69
400 - 500 500 - 750 750 - 1000 Over 1000	0.39 0.42 0.35 22.30		429.95 650.06 789.86 18,822.02	33.69	0.01	18,75 <b>1.7</b> 0

<sup>&</sup>lt;sup>a</sup>Combining the weight intervals of 250 grains and above, the total number of steel fragments is 0.012 per cent.

(S) The tabulation of Tables VIII and IX shows that an extremely large number of fragments results from this projectile. From an average of three rounds, 70 per cent and 66 per cent of the steel and aluminum fragments, respectively, are in the smallest weight interval, 0 to 1 grain. This high percentage of fragments accounts for only 4 to 5 per cent of the total weight of both steel and aluminum. It is also in this weight interval that the difference of approximately 11,000 fragments occurs between the number of steel fragments for Round 2 and that of the other two rounds. The number of fragments excluding fragments in the 0 to 1 grain weight interval is given in Table X.

Table X (S). Scaled Number of Fragments, Excluding Fragments in O to 1 Grain Weight Interval

Round	Steel.	Fragments	Aluminum	Fragments	
Number	Number	Per Cent	Number	Per Cent	
1	19,516	26.4	4327	32.2	
2	21,144	34.3	5488	37.3	
3	22,480	31.3	5635	32.3	
Average	21,048	30.4	<i>5</i> 1 <i>5</i> 0	33.9	

#### 4. (S) CONCLUSIONS

#### It is concluded that:

- a. Projectile, 279-mm, XM390, Composition B loaded, will produce an average of 69,137 steel fragments with average weight of 2.74 grains, and an average of 15,191 aluminum fragments with an average weight of 3.28 grains, with a mean initial velocity of 48% feet per second.
- b. Seventy per cent of the total number of scaled steel fragments were in the weight interval of 0 to 1 grain.
- c. Sixty-six per cent of the total number of scaled aluminum fragments were in the weight interval of 0 to 1 grain.
- d. A lethality study is being conducted by Weapons Systems Laboratory, BRL and the results will be included in their report.

#### 5. (S) RECOMMENDATIONS

In view of the high number of small fragments (0 to 1 grain) produced by the pearlitic malleable iron warhead, further study should be conducted using another explosive filler. Since the brisance of TMT is less than that of Composition B, it is recommended that the warhead be tested using TMT as an explosive filler.

SUBMITTED:

*J***. T. DEMPSEY** Ordnance Technician

REVIEWEDS

V. L. GRAFTON

Chief, Terminal Effects

and Special Projects Branch

C. E. BROWN

Chief, Infantry and

Aircraft Weapons Division

Assistant Deputy Director for Engineering Testing

Development and Proof Services

### REFERENCES (U)

- 1. Technical Memorandum Report ORDBB-TE5-12. Feltman Research and Engineering Laboratories, Picatinny Arsenal, Dover, N. J.
- 2. Technical Memorandum Report ORIBB-TK-391. Feltman Research and Engineering Laboratories, Picatinny Arsenal, Dover, N. J.

### APPENDICES (U)

		PAGE
APPENUIX A:	CORRESPONDENCE	<b>A-1</b>
APPRICIA B:	ANALYTICAL LABORATORY REPORT	B-1
APPENDIX C:	DISTRIBUTION	C-1

ORDNANCE CORPS
PICATINNY ARSENAL

APPENDIX A
Correspondence /

DOVER, NEW JERSEY 1r. E. Barrieres/ss/2277

IN REPLY
REFER TO:
PELTMAN RESEARCH AND ENGINEERING LABORATORIES
ORDER-TE5

OCT 8 89 12 PM

SUBJECT: Projectile, Atomic, 279AM, Practice, Spotting, XE390, (Project TN2-8051) (C)

TO: Commanding General
Aberdeen Proving Ground
Aberdeen, Maryland

ATTENTION: ORDBG-DP-TI, Mr. M. Raabe

- (C) 1. It is requested that complete fragmentation data be obtained for the X1390 Projectile at various heat treat conditions on the malleable iron warhead. Three projectiles are furnished incorporating warheads of 70,000 psi minimum yield, three of 50,000 psi minimum yield and two each of 32,500 psi minimum yield. The desired data should include fragment velocity, fragment mass and spatial distribution. This data should be segregated by heat treatment in order to evaluate the effect of heat treat on lethality. Fragment velocity is expected to be in the order of 6,000 ft./sec.
- (U) 2. It is desired that the Analytical Laboratory oversee the test procedure and set-up. Further, it is desired that the Analytical Laboratory reduce the data obtained and put the information in a form acceptable to the Weapons Systems Laboratory of the Ballistic Research Laboratories.
- (U) 3. The Weapons Systems Laboratory of ERL is requested to calculate the lethality of each of the three heat treat conditions based on the fragmentation data furnished.
- (U) 4. The average metal parts weight of the warhead alone is approximately 27 pounds; the charge is 16.33 pounds of Composition B. The actual measured metal parts weight and charge weight will be included on data cards which will accompany the shipment.
- (C) 5. Drawing No. AA-44-929, inclosed, shows the complete projectile assembly. Only the outer envelope of the projectile will be used; i.e., only those components affecting fragment velocity or distribution. Also inclosed is Drawing AA-44-921: the warhead loading assembly.

ORDBB-TE5

SUBJECT: Projectile, Atomic, 2791M, Practice, Spotting, XM390 (Project THZ-8051)(C)

- (U) 6. Funds for this work are available at your Proving Ground on Project TN2-8051, 015 Code #5530.12.533AD.12.
- (S) 7. Since this item is part of the Davy Crockett program, test scheduling and data reduction should be conducted as soon as possible in accordance with the high priority assigned to this program. It is desired that notification of the test date be furnished at least three days in advance of the test to permit attendance by interested Arsenal personnel.

FOR THE COMMANDER:

J. A DULLIN Assistant

Z Incls

1. Dwg. No. AA-44-929 (C)

2. Dwg. No. AA-44-921 (U)

CG:

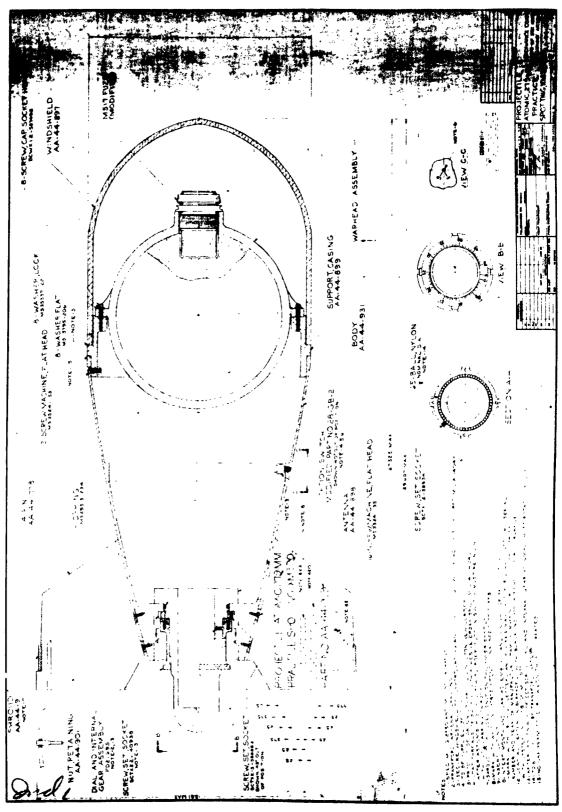
APG, ORDBG-D&FS w/o Incls
Analytical Lab

APG, ORDBG-BRL w/o Incls

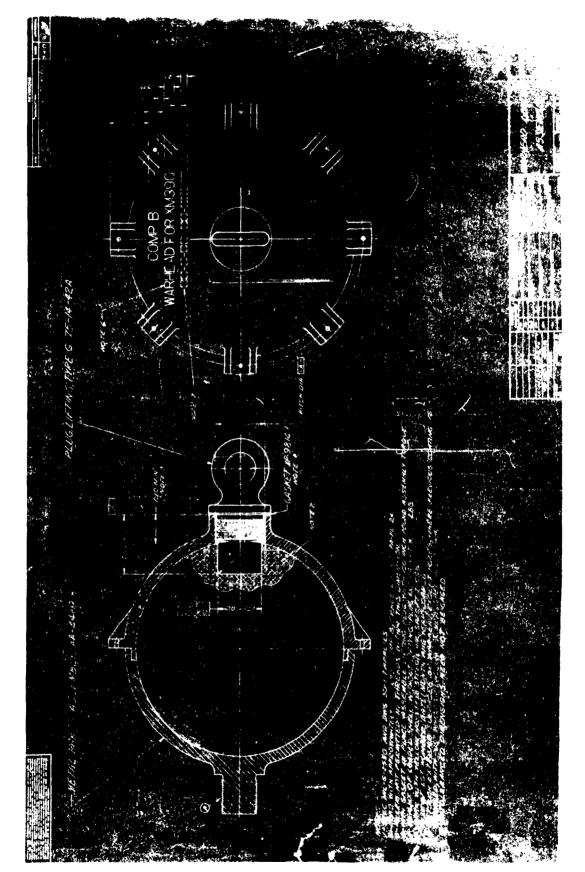
Weapons Systems Lab.

OSWAC w/o Incls

### CONFIDENTIAL



CONFIDENTIAL



# ORDNANCE CORPS PICATINNY ARSENAL

DOVER, NEW JERSEY lr. EBarrieres/ss/6208

IN REPLY REFER TO: PELTMAN, RESEARCH AND ENGINEERING LABORATORIES ORDED: IES

JM1 4 10 -3 PM

SUBJECT: Weights of Components of XM390 Fragmentation Projectiles

TO: Commanding General
Aberdeen Proving Ground
Aberdeen, Maryland
ATTENTION: ORDBG-DP-TI, Mr. M. Raabe

- 1. In accordance to your request, forwarded are the component weights of the XM390 fragmentation test projectiles, lot number PA-E-30478. Actual measured weights were not recorded for the shell components so that the weights supplied are nominal weights for each component. Individual scrialized weights are supplied for the warheads metal parts assembly, loaded warhead, and assembled projectile.
- 2. It will be noted that weights are supplied for those components of the incomplete projectile as supplied for testing. Not included were the Fin, Shroud, Setting Dial, Option Switch, and Tactical Fuze.

#### Shell Component Weights:

Windshield, AA-44-897		5.92#
Antenna, AA-44-898 including Retaining Nut,	<b>AA</b> -44-901 -	5.85#
Casing Support, AA-44-899		3 <b>.</b> 35#
Body, AA-44-931		7.38#

#### Serialized Warhead Weights:

Warhead s/n FA-64-59.	
Metal Parts (unloaded)	27.6#
Loaded Warhead	44 <b>.</b> 23#
Comp. B charge (by difference)	16.63#
Total Projectile Weight*	66, 5#

Warhead s/n PA-65-59	
Metal Parts	27.53#
Loaded Warhead	44.00#
Comp. B charge	16.47#
Total Projectile Weight*	66,80

<sup>\*</sup>Projectile Weight measured with lifting plug installed in warhead.

### ONDBH-TE5

SUDJECT: Weights of Components of MI390 Fragmentation Projectiles

Warhead s/n FA-65-59	
Metal Parts	27 <b>.</b> 33#
Loaded Warhead	44.CO#
Comp. B charge	16.67
Total Projectile Weight*	65.90#

FOR THE COMMANDER:

E. H. BUCHANAN

Assistant

#### APPENDIX B

Analytical Laboratory Report 60-AL-34 14 March 1960

Title: Results of Fragmentation Test of 279mm Projectile, XM390

Project No.: TN2-8051/100

Prepared for: Bomb & Fragmentation Branch, Inf & Acft Wpns Div

#### (U) INTRODUCTION

A static fragmentation test was conducted to obtain velocity, mass and spatial distribution of fragments for the 279mm, XM390 Projectile. Three rounds were tested for this purpose. These rounds were Comp B loaded and had warheads of pearlitic malleable iron with a yield strength of 50,000 psi. Also, the rounds were tested without the fin assembly. This report discusses the procedure used to obtain the data and presents the data in the form required by EDVAC for lethality studies.

#### (U) DESCRIPTION OF TEST ARENA

A square fragmentation arena was used for this test. In this arrangement, the recovery area consists of 4 ft by 8 ft sheets of cellotex stacked to a suitable depth and placed in a rectangular pattern from 0° to 180° as measured from the nose to the base of the shell. The other side of the arena, also rectangular, was used for velocity measurement. The velocity panels consist of 4 ft by 8 ft sheets of 0.020 inch dural with photoflash bulbs mounted behind them for backlighting, and aluminum foil to serve as a reflection surface.

Since the shell is symmetrical about its axis, the fragmentation characteristics are assumed to be symmetric, i.e., the fragment velocity, density, and spatial distribution obtained from one region are assumed to be equivalent to those of the symmetrically located region. Because of the possibility of irregular shell break-up in the nose and base areas, recovery boxes were placed outside the velocity targets at the nose and base ends.

The recovery area was divided into angular intervals or zones, numbered 1 through 19, from the nose to the base of the shell. Zones 1 and 19 covered the angular interval 0° to 5° and 175° to 180°, respectively, as measured from the axis of the projectile. Zones 2 through 18 covered the angle from 5° to 175° for each interval of 10°. The extra recovery boxes were placed at the nose, to recover fragments in areas symmetric to Zones 1 and 2, and at the base to recover fragments in areas symmetric to Zones 18 and 19. The rounds for this test were located with the base (antenna) directed toward 180°.

The velocity panels were also divided into somes corresponding to those of the recovery area. To aid in locating hits on the film for velocity measurements, horizontal lines 2 feet apart, were painted on the panels.

If measure and 545 with Leval or not attachers the descendence of the contest pundance and the descendence with paragraph 64 AR380-5

B-1

A sketch of the test arena is shown in Figure 1, Inclosure 1.

#### (U) PROCEDURE FOR COLLECTING DATA

#### Weight of Fragments

After each round was detonated, the fragments were recovered from the cellotex, located with regard to zone, separated according to type of metal (steel or aluminum), and weighed to an accuracy of 1% or a minimum of 0.01 grains.

#### Velocity of Fragments

High speed cameras (approximately 10,000 frames per second) were positioned so as to view the dural targets. The flashes of the fragment impacts on the dural were then recorded on the film record along with a millisecond time base. The flashbulb backlighting provided an additional source of light and made possible the recording of impacts that were produced by fragments with velocities too low (less than approximately 1700 fps) to produce a flash. The backlighting also provided more even illumination of each perforation then that normally obtained from impact alone. The photographic velocities, V<sub>D</sub>, were determined from the time of flight for each fragment and the known travel distance. These distances from surface of shell to the target were calculated in such a manner that the error in the travel distance was less than 1%. The velocities were then grouped into the same angular intervals as the fragment weight data.

A detailed description of the methods used in collecting and reducing fragmentation data is contained in Report No. D&PS/Misc/306 dated September 1959.

#### (U) REDUCTION OF DATA

#### Initial Velocity of Fragments

The initial velocities,  $V_{\rm O}$ , of the fragments for each angular interval were obtained from the equation

$$V_{o} = V_{p} = \frac{\frac{\text{ar}}{\text{m}^{1/3}}}{\frac{\text{ar}}{\text{m}^{1/3}}}$$

where a = 12 K<sub>d</sub> 
$$\rho$$
 K<sup>-2/3</sup>; K =  $\frac{m}{A^{3/2}}$ 

The parameters needed to evaluate  $V_{\rm O}$  by this relation were obtained as follows:

60-AI-34

 $V_{\rm p}$  - Photographic velocity (fps) is the median of the velocities for each some. These velocities were determined by the relation r/t where r was the travel distance and t was the time of flight.

 $K_d$  - The value of  $K_d$  (Drag coefficient) = .64 was obtained by determining an average value for  $K_d$  over the range of fragment velocities.  $K_d$  as a function of Mach number for a particular shaped fragment was obtained from ERL Report No. M-915.

 $\rho$  - For air density a standard value of .304332 grains/in.<sup>3</sup> (standard at APG) was adjusted to conditions at the time of firing by using the relative air density obtained from the Meteorological Section, Development and Proof Services.

K - The fragment shape factor was determined from the relationship  $M/A^{-3/2}$  where m is the fragment weight in grains and A is the average presented area of the fragment. A sample of steel and aluminum fragments was selected from the fragmented rounds and the presented areas were measured by means of the icosahedren gage at ERL. From a least square fit of M and  $\overline{A}$ , values of 719 and 296 were determined for K for steel and aluminum fragments, respectively.

 $m_T$  - The representative fragment weight was determined as the fragment weight corresponding to the median of the number of fragments recovered but excluding the heavy fragments and those in the O-1 grain interval.

#### Number and Density of Fragments

The scaled total number of steel and aluminum fragments for each round was calculated from the scaled fragment densities obtained from the recovery data. The total number of fragments N was calculated by the equation

$$N = 2\pi \int_{0}^{\pi} (\Theta) \sin \Theta d\Theta$$

where  $\theta$  is the angle from the nose end of the shell axis and  $O'(\theta)$  is the scaled number of fragments per unit solid angle for each  $10^{\circ}$  interval. The term "scaled" refers to an adjustment of data based on the percent of recovery.

#### (U) RESULTS

The calculated results are tabulated for each round and for the three-round average in Inclosure 2. The data are arranged in the form required by the EDVAC code for the computation of lethal areas. The fragment spray density, and the median initial velocity, V<sub>O</sub>, are given for each 10° interval from 0° to 180°.

60-AL-34

The mean, m, of the fragment weights, in each weight interval and the ratio, q, of the number of fragments in each weight interval to the total number of fragments in the angular interval are given for each weight and angular interval.

It should be pointed out that the values of velocity, density, etc. that are tabulated for each angular interval, were computed from data obtained for a given angular width. Therefore, these are considered to be average values applicable at the midpoint of each angular interval, i.e., values given for  $\theta = 60^\circ$  were derived from data obtained from  $\theta = 55^\circ$  to  $\theta = 65^\circ$ .

#### Graphs

Graphs of the pertinent data: distribution of fragment weight and number, density, and velocity are presented in Figures 2-10, Inclosure 1.

#### (8) DISCUSSION OF RESULTS

The following table shows the weight data supplied by Picatinny Arsenal for the three rounds.

#### Weight in Pounds

Rd No.	Warhead Metal Parts	Explosive Filler	Antenna Assemblya	Casing Support & Body	Wind- shield <sup>a</sup>	<u>Total</u>	<u>Fuze</u> b
1	27.60	16.63	5.85	10.73	5.92	66.50	1.50
2	27.53	16.47	5.85	10.73	5.92	66.80	1.52
3	27 • 33	16.67	5.85	10.73	5.92	65.90	1.50

<sup>&</sup>lt;sup>8</sup>Nominal weights <sup>b</sup>Modified M51A5 fuze supplied by APG

Two types of metal, steel and aluminum, were primarily involved in the fragments of these rounds. For the weight of the steel in each round, the weights of the varhead metal parts, antenna assembly and fuze were combined. For the aluminum components, the casing support and body, the nominal weight shown above was used for all three rounds. The windshield was non-metallic and appeared to be a molded plastic with cord reinforcing. No reduction of data was performed involving the windshield.

60-ai-34 5

The weight and number of fragments actually recovered are as follows:

#### Actual Recovery Data

Steel Fragments				Aluminum Fragments			
Rd. No.	Total Wt. gr	Total No.	Ave Wt, a	Total Wt, gr	Total No.	Ave Wt, D	
1	54623.25	5366	2.07	21224,33	810	2.87	
2	54876.13	4047	2.83	20638.44	<b>70</b> 9	2.65	
3	55824.79	4984	2.32	20423.91	877	2.06	

The average steel fragment weights were determined by excluding large fuze and antenna parts which did not break up. For all three rounds one large fuze fragment weighing approximately 4500 grains was recovered. For Rounds 1 and 2, one large piece of the antenna weighing approximately 38,500 grains was recovered and for Round 3 two pieces of antenna with a combined weight of 40,515 grains were recovered.

The average aluminum fragment weights were determined by excluding one large fragment weighing approximately 18,750 grains for all rounds. This fragment was from the rear part of the body around the antenna.

Integration of the actual recovery data to account for complete fragmentation data (360° around the axis of the shell) resulted in the values given in the following table.

#### Integrated Recovery Data

	All Fr		Excludi	ng Large Fr	rags <sup>C</sup> .
Rd.	Total	No. of	Total	No. of	Ave Frag
No.	Wt, 1b	Frags	Wt, 1b	Frags	Wt. gr
		. 8	teel Fragments		
1	28,28	59,860	22.05	59,858	2.58
2	27.16 <b>26.</b> 68	47,937	20.95	47,935	3.06
2 3	<b>26.</b> 68	47,937 59,410	22.36	47,935 59,407	2.63
		Al	uminum Fragment	i 8	
1	8.93	11,164	6.23	11,163	3.90
2 3	8.93 7.64 7.44	10,476	\.\.96 4.78	10,475 12,098	
3	7.44	12,099	4.78	12,098	3.32 2.77

<sup>&</sup>lt;sup>C</sup>See notes a and b above.

60-AL-34

Since similar large fragments were recovered for all rounds for both the aluminum and steel, the recovery percentages were computed using the above total integrated weights. All rounds were then "scaled" or adjusted to 100 percent recovery. The recovery percentages and scaled data are presented for each round and the average of the three rounds in the following table.

	Steel Fragments					Aluminum Fragments			
Rd No.	As-fired Wt, lb	Percent Recovery	Scaled No. of Frags	Ave Frag Wt, gr	As-Fired Wt, 1b	Percent Recovery	Scaled No. of Frags	Ave Frag Wt, gr	
1 2 3 Ave	34.95 34.90 34.68 <b>34.84</b>	80.9 77.8 82.7 80.5	73,986 61,598 71,826 69,137	2.58 3.06 2.63 2.74	10.73 10.73 10.73	83.2 71.2 69.4 74.9	13,419 14,708 17,447 15,191	3.90 3.32 2.77 3.28	

The above tabulation shows that an extremely high number of fragments results from this projectile. However, from the plot of the percent of weight and number of fragments versus weight interval, Figures 4 and 5, Inclosure 1, it can be seen that for the average of the three rounds 70% and 66% of the steel and aluminum fragments, respectively, are in the smallest weight interval, 0-1 grain but that these high percentages of fragments account for only 4-5% of the total weight of both steel and aluminum. It is also in this weight interval that the difference of approximately 11,000 fragments occurs between the number of steel fragments for Round 2 and that for Rounds 1 and 3. A comparison of the number of fragments excluding fragments in the 0-1 grain weight interval is given below.

## Scaled Number of Fragments Excluding Fragments in O-1 Grain Weight Interval

Rd	St	ceel Fragments	Aluminum Fragments		
No.	Number	Percent of Total	Number	Percent of Total	
1	19,519	26.4	4327	32.2	
2	21,144	34•3	5488	37•3	
3	22,480	31.3·	5635	32.3	
Ave	21,048	30.4	5150	33•9	

Reference to the plot of accumulated number of all fragments versus angle  $\theta$ , Figure  $\theta$ , Inclosure 1, shows further that the differences in steel fragments for Round 2 occurred in the rear part of the projectile for an angle  $\theta$  from approximately  $120^{\circ}$  to  $160^{\circ}$ .

60-AL-34

The differences in the number of aluminum fragments for each round could not be resolved by eliminating the 0-1 grain fragments. It appeared that there were two areas of irregular break up contributing to these differences; one at approximately 110° and the other at approximately 160°.

The fragment densities are plotted for the individual rounds and the average of the three rounds, Figure 3, Inclosure 1. These plots show the highest densities to be in the rear section with the maximum value for steel fragments at an angle of  $160^{\circ}$  from the fuze end of the round, and  $150^{\circ}$  for the aluminum fragments. To show the effect of the small fragments (0-1 grain), densities were computed and plotted excluding these small fragments, Figure 4, Inclosure 1. These charts show that the greatest effect of the 0-1 grain fragments on density occurred at the fuze end, from approximately  $0^{\circ}$  -  $10^{\circ}$  for the steel fragments and to an even greater degree, from approximately  $130^{\circ}$  -  $180^{\circ}$ , for both steel and aluminum. Since no aluminum fragments were recovered from approximately  $0^{\circ}$  -  $70^{\circ}$ , this indicates that the aluminum body probably caused secondary breakup of the steel fragments from the warhead.

In obtaining fragment velocities, there was a slight indication of a bimodal distribution of the photographic velocities from approximately 120° - 160°, presumably due to the presence of steel and aluminum fragments. In an attempt to obtain more information on velocity levels of the two types of fragments, extra velocity panels (4 ft x 8 ft) were placed above the corner sections of the recovery area, i.e., at angles of 45° and 135° for Round No. 3. These panels were installed with cellotex behind them to enable recovery of the fragments perforating the dural sheets, thus providing association of the fragment type and weight with velocity. However, insufficient data were obtained to add any information about the aforementioned bimodal distribution.

For the extra panel at 135°, 154 perforations were recorded, of which 84 were identified with steel fragments and 7 with aluminum fragments, with the end result that velocities were obtained for 36 steel fragments and only 2 aluminum fragments. Nevertheless, while the data from the extra panels did not enable separation of steel and aluminum fragment velocities, the data substantiated the wide dispersion of photographic velocities, approximately 2500 fps (3000-5500 fps) encountered on the normal velocity panels for the corresponding angle and further showed that this dispersion of velocities was occurring with the steel fragments. The small number of aluminum fragments identified for the extra panel was apparently due to the inability of the aluminum fragments to perforate the shell of dural.

For the extra velocity panel at 45°, only steel fragments were recovered. The total number of perforations for this panel was 43, for which 30 fragments were recovered. Velocities were obtained for 27 %f these fragments. The velocity results for this panel also substantiated the velocity dispersion occurring with the corresponding normal velocity targets.

60-AL-34

Since no separation of the photographic velocities was possible for the two types of metal, the initial velocities were computed using the drag characteristics for steel fragments. These initial velocities were then considered applicable to both steel and aluminum fragments. This method appeared most practical in view of the configuration of the round in which the explosive charge was confined by the steel warhead with aluminum body several inches away from the charge.

In computing the initial velocities, the representative fragment weight, m<sub>r</sub>, was computed as the fragment weight corresponding to the median of the number of fragments recovered after tabulating the weight data by weight intervals and excluding fragments in the 0-1 grain weight interval and a few large fragments. While the usual procedure for determining the representative fragment weight is to compute the fragment half-weight for each zone, the computed fragment half-weights for these rounds were relatively large and appeared to represent a much lower number of fragments than the number of velocities obtained for each zone. The values of m<sub>r</sub> thus determined by finding the median of the modified number of fragments recovered were influenced very little by any one fragment, and exhibited less variation from zone to zone, than the values obtained using the fragment half-weight method. For all three rounds the values of m<sub>r</sub> used in computing initial velocities varied from 1.60 to 10.00 grains.

To illustrate the difference in representative fragment weights obtained by the two methods, the data from Round 3, Zone 6, (angular interval 450 - 550) are given. In this zone, 73 steel fragments of which 45 weighed less than 1 grain, were recovered, and 41 velocities were read from the film. Use of the fragment half-weight method resulted in a weight of 21.18 grains for m<sub>r</sub> as compared to a weight of 4.45 grains obtained by the method based on the number of fragments. Since only five fragments weighed 20 grains or more, it was felt that this weight did not represent those fragments for which velocities were obtained. Computation of initial velocity using these two weights would result in a difference of approximately 700 fps (i.e. 5550 and 4850 fps for 4.45 and 21.18 grains, respectively).

In determining the number of fragments N(m) for the entire round greater than weight (m) according to Mott's Law, it was found that the relation N(m) vs  $m^{1/3}$  produced a better fit than N(m) vs  $m^{1/2}$  for the steel fragments. The resulting equation for the steel fragments,  $\log_{10}$  N(m) = 4.943 - .61723  $m^{1/3}$ , was determined excluding fragments greater than 400 grains which amounted to considerably less than 1% of the total number, see Figure 9, Inclosure 1. The above equation agrees with the observed values very well for weights from 1 to 400 grains, but gives values too high for fragments weighing less than 1 grain.

A similar relationship was determined for the aluminum fragments, Figure 10, Inclosure 1, and is expressed by the equation  $Log_{10}$  N(m) = 4.201 - .51053 m<sup>1</sup>/3. This equation agrees well with the observed results of m from 0 - 50 grains. Fragments weighing more than 50 grains, for which the equation gives values too high, were not used in determining the above equation.

60-AL-34

#### (s) CONCLUSIONS

Based on the results of this test the subject XM-390 Projectile, Comp B loaded having a pearlitic malleable iron warhead of 50,000 psi yield strength, will produce approximately 70,000 steel fragments and 15,000 aluminum fragments of which approximately 70% of each type will be fragments weighing less than one grain.

SUBMITTED:

Henry L. Barnhart

Mathematician

REVIEWED:

Joseph E. Steedman foseph E. Steedman

Chief, Ballistics Section

Chief, Analytical Laboratory

Engineering Laboratories Supporting Services Development and Proof Services

Aberdeen Proving Ground, Maryland

2 Incls

Incl 1

Figure 1 - Sketch of Fragmentation Arean (1)

Figure 2 - Plots of Initial Velocity vs Angle (lp)

Figure 3 & 4 - Plots of Fragment Density vs Angle (2p)

Figure 5 & 6 - Graphs showing \$ Weight and Number vs Weight Interval (2p)

Figure 7 - Plot of Scaled Integrated Number vs Angle (1)

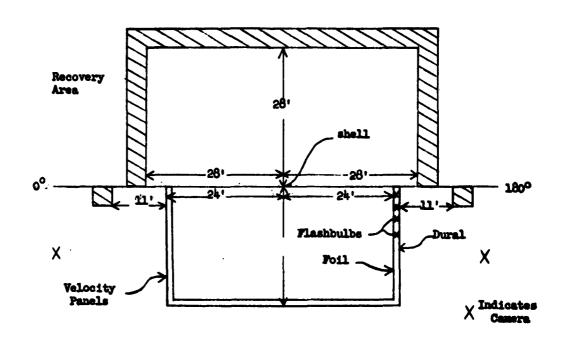
Figure 8 - Plot of Accumulated Number vs Angle (lp)
Figure 9 & 10 - Plots of M(m) vs m<sup>1/3</sup> (2p)

Incl 2

Tabulated Data (35p)

60-AL-34 10

Fragmentation Arena



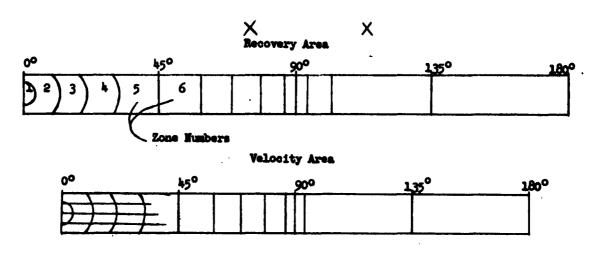
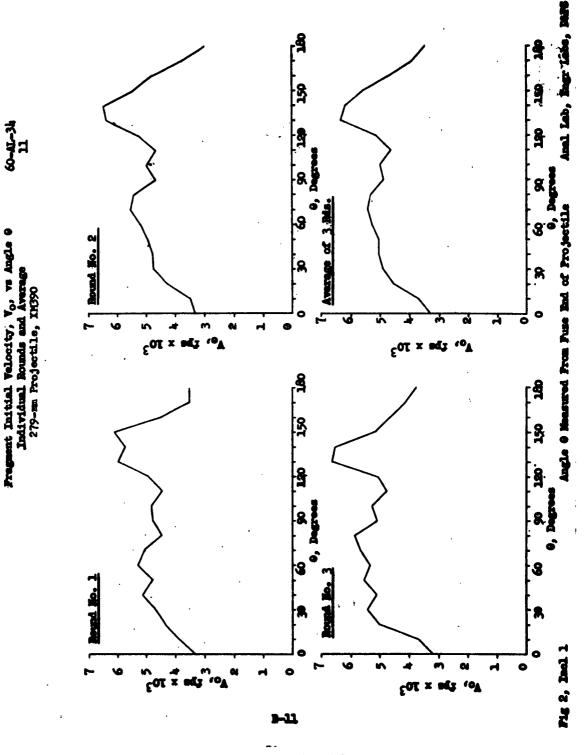


Fig 1, Incl 1

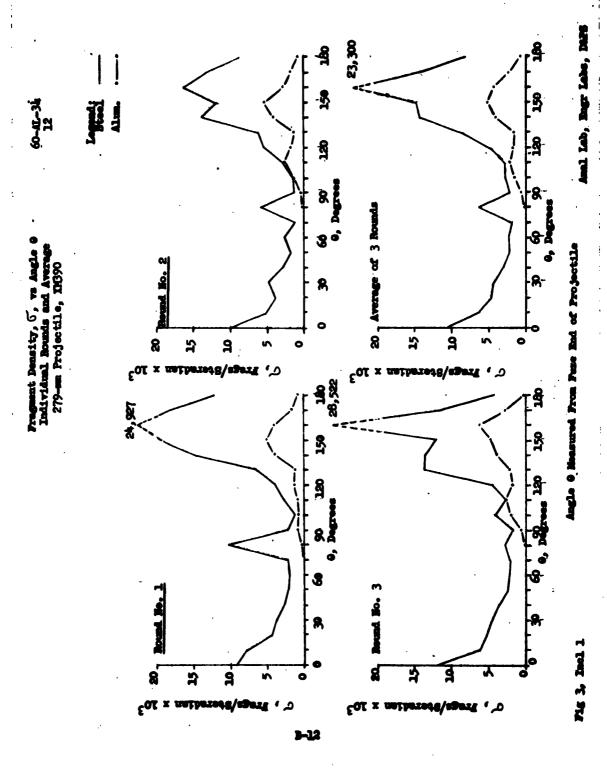
Anal Lab, Engr Labs, Dars

SECRET

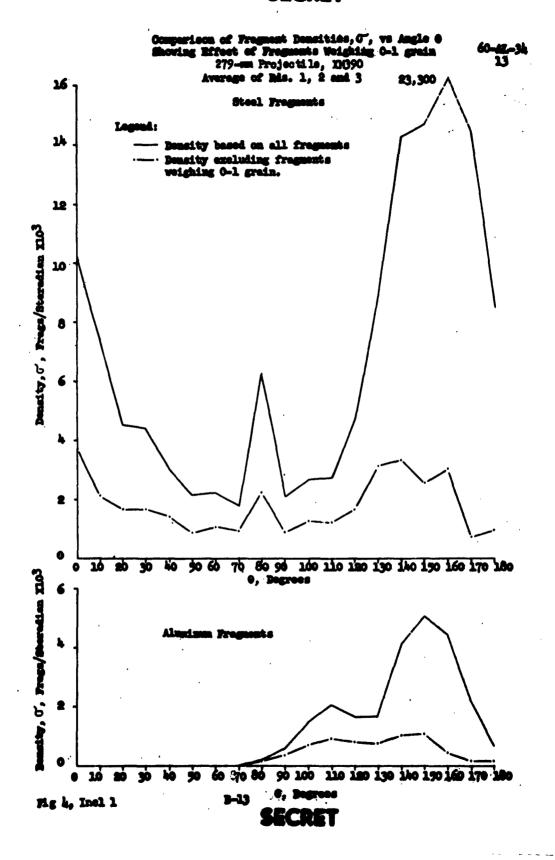
3-10



SECRET

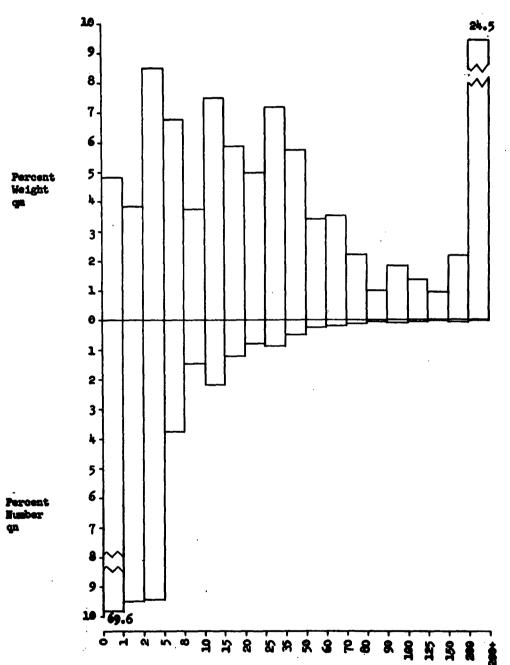


SECRET



Percent Weight and Number (qm, qn) vs Weight Interval
279-mm Projectile, XM390

Average of hounds 1, 2, & 3 Steel Fragments



Weight Interval, Grains

Fig 5, Incl 1

B-14 Anal Lab, Engr Labo, DAPS RECOET

Percent Weight and Number (qm, qm) vs Weight Interval 60-AI-34 279-mm Projectile, XMG90

Average of Rounds 1, 2, & 3

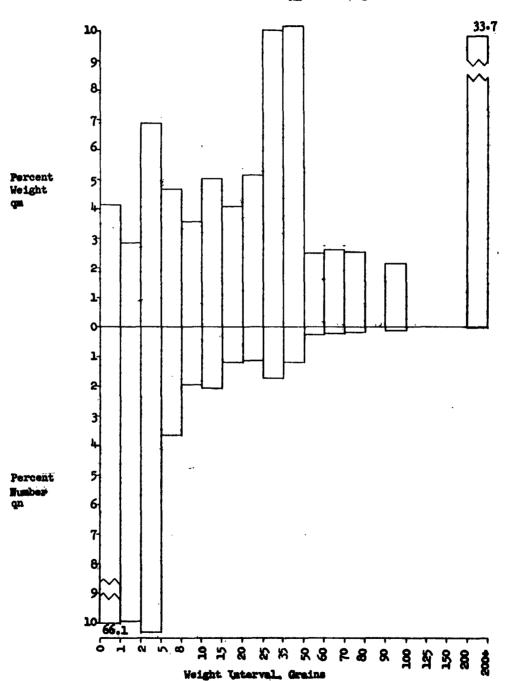


Fig 6, Incl 1

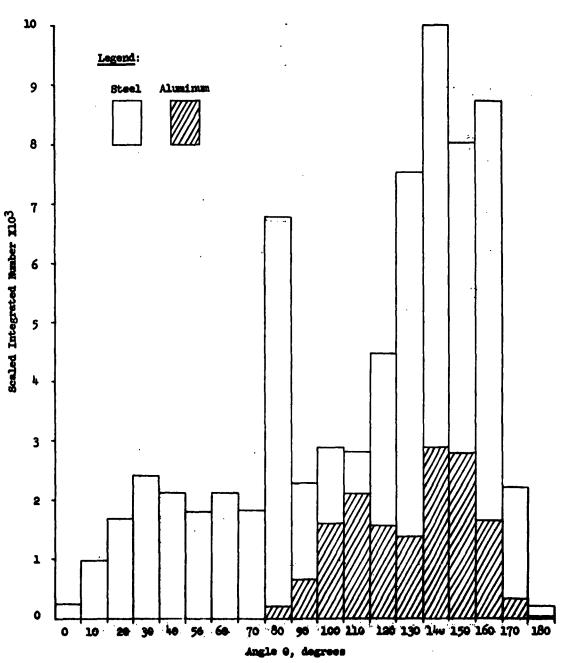
SECRET

Anal Lab, Engr Labs, DAFS

Scaled Integrated Number of Fragments

60-11-34 16

Angle 0
279-mm Projectile, XMG90
Average of Rds. 1, 2 and 3

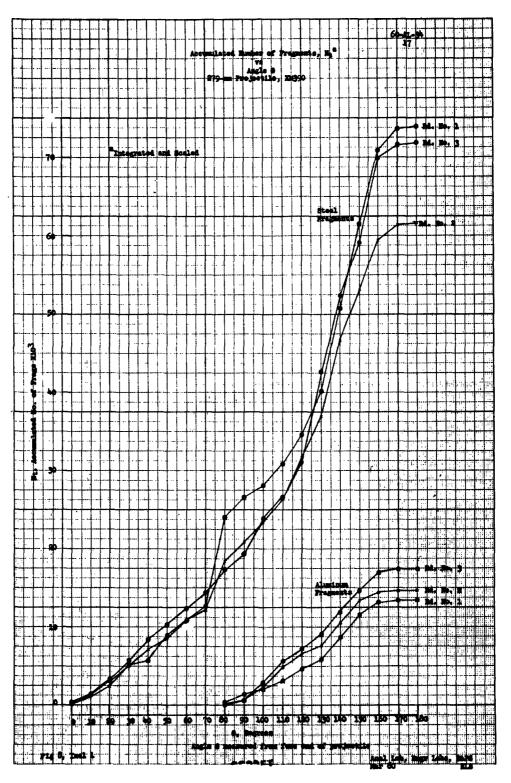


Incl 1, Figure 7

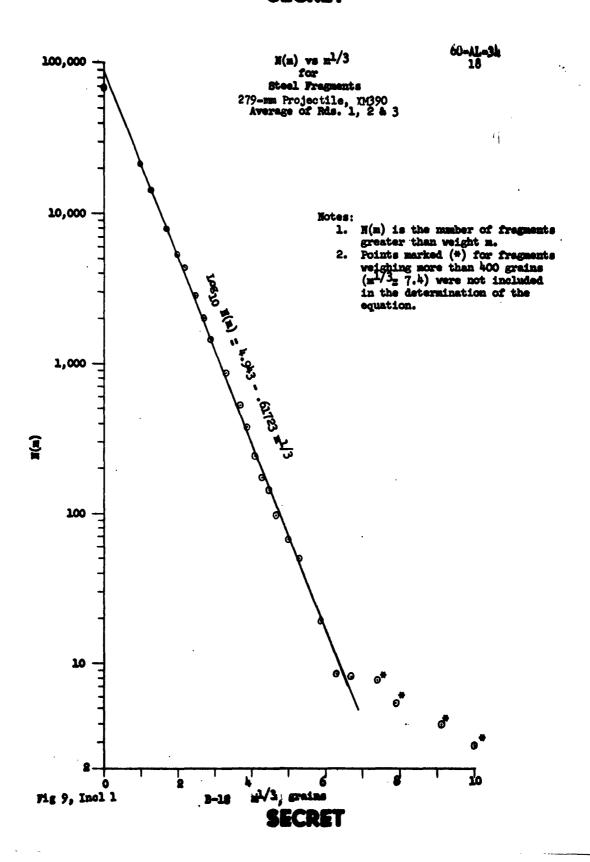
B-16

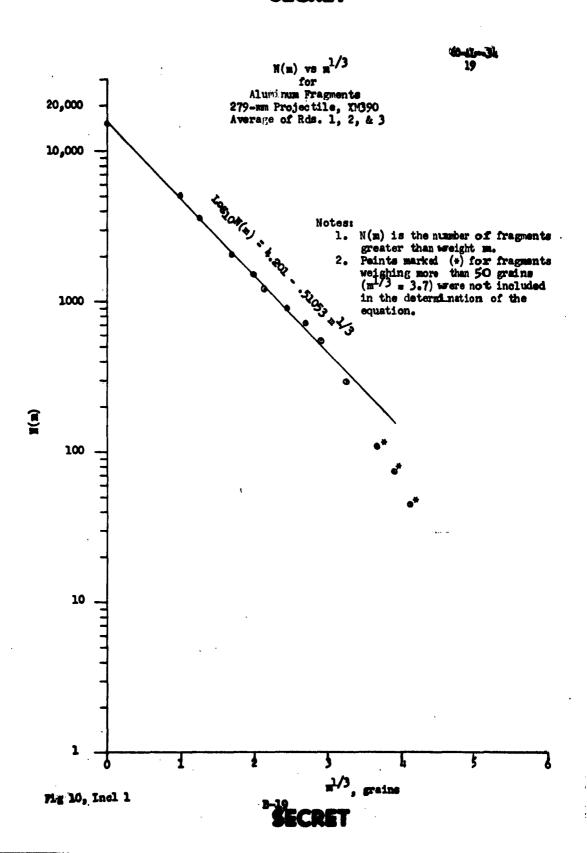
SECRET

Anal Lab, Engr Labe, DAPS Mar 60 ELB



B-17
SECRET





60-41-31 20

### Fragment Velocity and Density

Average of Rd. Nos. 1, 2, & 3 Date of Firing: 30 Dec 1959, 12, 25 Jan 1960 Steel Fragments

0 Degrees	Initial Velocity, Vo	Density, Frags/Steradian
0	3300	10287
10	3700	6324
20	4550	4525
30	4900	4525 4414
30 40	5050	3032
50	5050	2145
50 60	5300	2239
70	5450	1785
80	5350	1785 6272
70 80 90	5350 4900	2095
100	5000	2672
110	1650	2735
120	5150	47 <b>1</b> 3
130	5150 6350 6200	8963
130 140	6200	14206
150	5600	14638
150 160	4700	22200
170	3950	23300 14363
170 180	3500	8491
~~	3700	O49L

ar 1/3

In the equation  $V_T = V_0e$  where  $V_T$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .029 for Standard Conditions

Percent Recovery = 80.5

Anal Lab, Engr Labe, Dars Mar 60

Fragment Velocity and Density

Average of Md. Nos. 1, 2, & 3 Date of Firing: 30 Dec 1959, 12, 25 Jan 1960 Aluminum Fragments

0 Degrees	Initial Velocity, Vo	Density, Frags/Steredian
0-70	No Aluminum Fragments Recovere	
80	5350	192
90	5350 4900	599
100	5000	1479
110	5000 4 <b>650</b>	2046
120	5150	1648
130	6350	1642
140	6200	4102
150	5600	5077
160	4700	5077 4414
170	3950	2238
180	3500	2238 698

<del>1</del>/3

In the equation  $V_r = V_0e$  where  $V_r$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .053 for Standard Conditions

Percent Recovery = 74.9

Anal Lab, Engr Labs, DAPS Mar 60 #2

60-AL-34 29

### Fragment Velocity and Density

Round No. 1

Date of Firing: 30 Dec 1959

Steel Fragments

O Degrees	Initial Velocity, V <sub>o</sub> fps	Density, Frags/Steradian
0	3350	9047
10	3850	7751
20	4350	4385
30	4700	3706
40	5150	2620
	4800	2379
50 60	5300	1993
70	5100	2212
8ŏ	4500	10205
90	4800	2381
100	4850	1323
110	4500	2665
120	4950	3985
130	6000	<b>66</b> 49
140	5750	14952
150	6150	19664
160	4500	24927
170	3550	18341
180	3550	12148
	3770	<del></del> • •

 $\frac{\text{ar}}{1/3}$ 

In the equation  $V_r = V_0 e^{m}$  where  $V_r$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .029 for Standard Conditions

Percent Recovery = 80.9

Anal Lab, Engr Labs, DAPS Mar 60 HLB



Bound No. 1

Bate of Firing: 30 Dec 1959

Aluminum Fragments

0 Degrees	Initial Velocity, Vo	Density, Press/Steredian
0-70	No Aluminum	Fragments Recovered
80	4500 4800	371
90	4800	371. 902
100	4850	767
110	4500	985
120	4950	9 <del>95</del> 1488
130	6000	1426
- 140		4070
150	5750 6150	
160	4500	5200 4190
170 180	3550	1786
180	3550	1786 855

- \_1/3

In the equation  $V_r = V_{oe}$  where  $V_r$  and  $V_o$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .053 for Standard Conditions

Percent Recovery = 83.2

Anal Lab, Hagr Labs, DAPS Mar 60 MG

Bound No. 2

Date of Firing: 12 Jan 1960 Steel Fragments

O Degrees	Initial Velocity, Vo fps	Density, Frags/Steradian
0	3350	9728
10	3500	5061
20	4300	3973
30	4750	4942
30 40	4750 4800	2757
50 60	4950	1728
60	5200	2522
70 80	5550	1136
80	5450	5847
90	4700	2163
100	5000	2461
110	4700	2881
120	5300	54 <b>6</b> 4
130	6400	6370
140	6500	13851
150	5500	11825
160	5500 4850	16450
170	3800	13052
180	3000	8975

ar \_1/3

In the equation  $V_r = V_{0e}$  where  $V_r$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .029 for Standard Conditions

Percent Recovery = 77.8

Anal Lab, Engr Labe, DAPS Mar 60 ELB

At the second

Bound No. 2

Date of Firing: 12 Jan 1960

Aluminum Fragments

0 Degrees	Initial Velocity, Vo	Density Frags/Steradian
0-70	No Alumin	m Fragments Recovered
80	5450	116
90	5450 4700	370
100	5000	1590
110	4700	1590 2542
120	5300	1739
130	6400	1333
140	6500	4210
150	5500	5046
150 160	4850	2738
170 180	3800	1940
1.80	3000	. 998

1/3

In the equation  $V_r = V_{0e}$  where  $V_r$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .053 for Standard Conditions

Percent Recovery = 71.2

Anal Lab, Engr Labs, DAFS Mar 60 ML2

Bound No. 3

Date of Firing: 25 Jan 1960

Steel Fragments

0 Degrees	Initial Velocity, V <sub>o</sub>	Density, Frags/Steradian
0	3200	12085
10	3700	6161
20	5000	5218
30	5450	4594
30 40	5150	3719
50 60	5550	2327
60	5350	2203
70	5760	2007
70 80	5900	2763
90	5100	1741
100	5300	4232
110	4800	2659
120	5100	4689
130	6650	13868
140	6550	13813
150	5200	12426
160	4700	28522
170	4700	11696
180	3800	4349

1/3

In the equation  $V_r = V_0 e^{\frac{\pi}{4}}$  where  $V_r$  and  $V_0$  are velocities in feet per second, m is weight in grains, and r is distance in feet,

a = .029 for Standard Conditions

Percent Recovery = 82.7

Anal Lab, Hagr Labe, DAPS Mar 60 Mil

B-26